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Fruits and Seeds of Genera in the Subfamily Faboideae (Fabaceae)

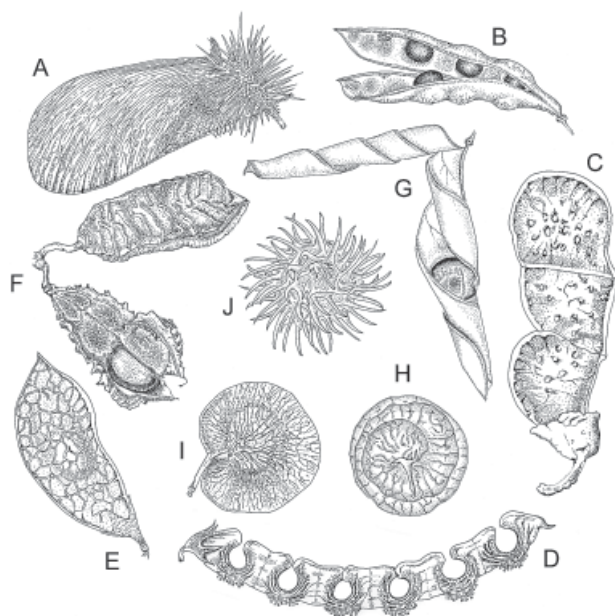
Volume II



Fruits and Seeds of Genera in the Subfamily Faboideae (Fabaceae)

Volume II

Joseph H. Kirkbride, Jr., Charles R. Gunn, and
Anna L. Weitzman



Fruits of A, *Centrolobium paraense* E.L.R. Tulasne. B, *Laburnum anagyroides* F.K. Medikus. C, *Adesmia boronoides* J.D. Hooker. D, *Hippocrepis comosa*, C. Linnaeus. E, *Campylotropis macrocarpa* (A.A. von Bunge) A. Rehder. F, *Mucuna urens* (C. Linnaeus) F.K. Medikus. G, *Phaseolus polystachios* (C. Linnaeus) N.L. Britton, E.E. Stern, & F. Poggenburg. H, *Medicago orbicularis* (C. Linnaeus) B. Bartalini. I, *Riedeliella graciliflora* H.A.T. Harms. J, *Medicago arabica* (C. Linnaeus) W. Hudson.

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Contents

Volume I

Procedures	3
Fruit morphology	4
Fruit	4
Loment	8
Epicarp	9
Mesocarp	12
Endocarp	13
Seeds	14
Funiculus	14
Aril	15
Seed morphology	16
Seed	18
Testa	20
Raphe	22
Hilum	24
Lens	26
Endosperm	28
Cotyledons	28
Embryonic axis	31
Radicule	31
Plumule	32
Seed key to three subfamilies of Fabaceae	33
Seed keys to genera of subfamily Faboideae	33
Master key to 16 seed keys and one genus	33
Seed key 1: Aril present; fleshy. Cotyledons entire over radicle.	33
Seed key 2: Aril present; fleshy. Cotyledons notched at radicle.	35
Seed key 3: Aril present; fleshy. Cotyledons split at radicle.	36
Seed key 4: Aril present; dry. Cotyledons entire over radicle. Hilum raised or flush.	38
Seed key 5: Aril present; dry. Cotyledons entire over radicle. Hilum recessed.	39
Seed key 6: Aril present; dry. Cotyledons notched at radicle. Endosperm present.	43
Seed key 7: Aril present; dry. Cotyledons notched at radicle. Endosperm absent.	48
Seed key 8: Aril present; dry. Cotyledons split over radicle. Hilum raised or flush.	52
Seed key 9: Aril present; dry. Cotyledons split over radicle. Hilum recessed.	54
Seed key 10: Aril absent. Cotyledons entire over radicle. Endosperm absent.	58
Seed key 11: Aril absent. Cotyledons entire over radicle. Hilum raised or flush. Endosperm present.	60
Seed key 12: Aril absent. Cotyledons entire over radicle. Hilum recessed. Endosperm present.	63
Seed key 13: Aril absent. One (1) cotyledon scooped out to accommodate plicate radicle and other cotyledon entire.	67
Seed key 14: Aril absent. Cotyledons notched at radicle.	67

Seed key 15: Aril absent. Cotyledons split over radicle. Hilum raised or flush.	71
Seed key 16: Aril absent. Cotyledons split over radicle. Hilum recessed.	73

Synopses of fruit and seed characters

Swartzieae (1.01-1.15)	78
Sophoreae (2.01-2.46)	118
Dipteryx-ae (3.01-3.03)	220
Dalbergieae (4.01-4.17)	226
Abreae (5.01)	270
Amorpheae (6.01-6.08)	274
Millettieae (A-X)	292
Robinieae (8.01-8.12)	388
Indigofereae (9.01-9.07)	424
Phaseoleae (10.01-10.83)	434

Volume II

Synopses of fruit and seed characters

Desmodieae (11.01-11.25)	636
Psoraleeae (12.01-12.09)	696
Loteae (13.01-13.17)	716
Aeschynomeneae (14.01-14.26)	754
Adesmieae (15.01)	810
Galegeae (16.01-16.22)	814
Carmichaelieae (17.01-17.05)	870
Hedysareae (18.01-18.07)	882
Fabeae (19.01-19.05)	894
Cicereae (20.01)	910
Trifolieae (21.01-21.06)	914
Brongniartieae (22.01-22.02)	934
Bossiaeeae (23.01-23.10)	938
Mirbelieae (24.01-24.26)	960
Podalyrieae (25.01-25.09)	1008
Hypocalyp- teae (26.01)	1028
Crotalarieae (27.01-27.11)	1030
Euchrest- eae (28.01)	1056
Thermopsi- deae (29.01-29.06)	1058
Genisteae (30.01-30.25)	1072
Character list	1130
Literature cited	1160
Scientific name index	1185

Desmodieae (11.01–11.25)

Genus: *Brya* P. Browne

Phylogenetic Number: 11.01.

Tribe: Desmodieae.

Subtribe: Bryinae.

Species Studied—Species in Genus: 4 spp.—4 spp.

Fruit a legume or loment (or loment segment); 0.8–2.5 (upper length is estimated) \times 0.6–0.9 \times 0.07–0.08 cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; straight or curved (or slightly curved); not plicate; not twisted; asymmetrical; moniliform (with more or less elongated isthmuses); when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near middle or D-shaped; not inflated; flattened; without beak; rounded at apex; apex oblique with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit substipitate or nonstipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 8–15 mm long; widest across seed area; with all essentially similar in shape; D-shaped or curved. Epicarp dull; monochrome; brown (dark reddish to greenish); pubescent and indurate; with 2 or 3 types of pubescence; puberulent; with pubescence gray (short and plain tipped) or golden (long and gland tipped); with golden hooked and gray plain hairs; with pubescence uniformly distributed; with simple and glandular hairs; pliable; with hair bases plain; glandular; with glandular hairs; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp more or less glossy; monochrome; tan; fibrous (to somewhat smooth in seed chamber); septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1 or 2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; flattened; curved. Aril absent.

Seed 3.5–5 \times 2–3.5 \times 0.5–0.6 mm; not overgrown; not angular; asymmetrical; reniform; flattened; with surface

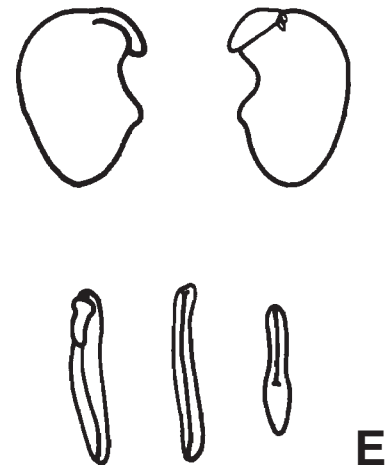
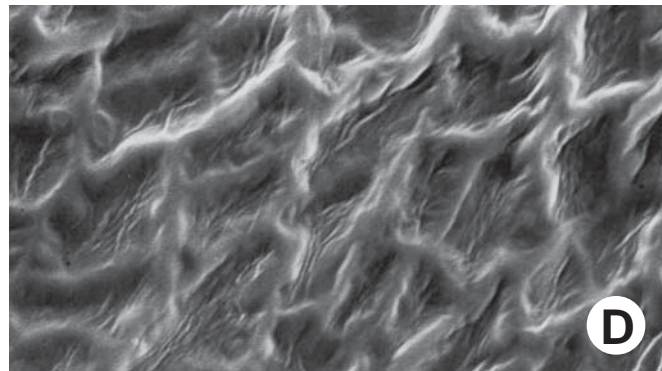
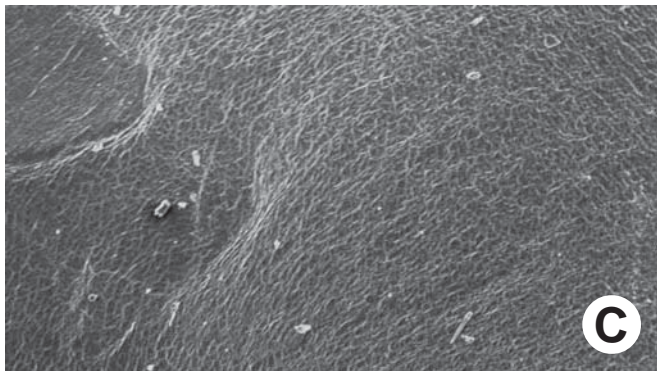
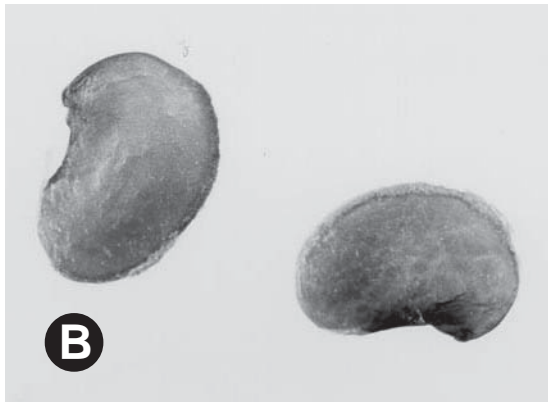
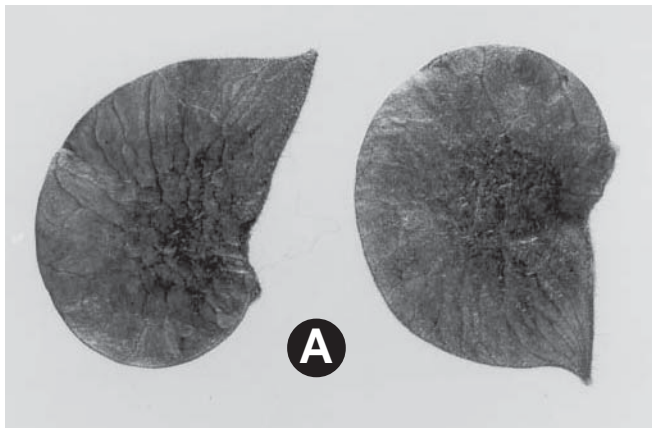
smooth; with visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from lens to base of seed and terminating; not bifurcating; darker than testa; dark reddish brown; raised. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform or larger than punctiform; 0.2–0.5 mm long; with straight outline; oblong; between cotyledon and radicle lobe; flush; within halo. Hilum halo color darker than testa. Lens not discernible. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; notched at radicle; with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; reddish tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Cuba (1 sp.) extending to Jamaica and another species to Hispaniola.

Notes: Ohashi et al. (1981) started their treatment of the *Desmodieae* with these thoughts: “A sensible classification of *Desmodieae* is prejudiced by the traditional over-weighting of fruit characters.” [sic] “The fruit normally consists of indehiscent jointed articles, but fruits that open have arisen at least seven times...” They supplemented their text with a fruit-seed plate. They placed *Brya* and *Cranocarpus* (11.02), the only two New World endemic genera, in the new subtribe *Bryinae*, “characterized most notably by glochidiate hairs.” Bailey et al. (1997), using the chloroplast *rpl2* intron and ORF184, suggested that *Brya*, *Cranocarpus*, *Phylacium* (11.22), and *Neocolletia* (11.26) are not members of *Desmodieae* and that they probably belong in *Aeschynomeneae* (14). Lewis (1988) provided a plate showing the fruit and seed of *B. ebenus*.

Brya: *B. ebenus* (C. Linnaeus) A.-P. de Candolle (A–E). A, Fruits (\times 3); B, seeds (\times 5.4); C–D, testa (\times 50, \times 1000); E, embryos (\times 5).

3



Genus: *Cranocarpus* G. Bentham

Phylogenetic Number: 11.02.

Tribe: Desmodieae.

Subtribe: Bryinae.

Species Studied—Species in Genus: 2 spp.—3 spp.

Fruit a loment (or loment segment or a 1-seeded loment); 1–2 × 0.5–0.8 cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; irregular or reniform; when asymmetrical with both sutures unequally curved or 1 straight and 1 curved; narrowing in several places, resembling *Desmodium* (11.09) fruit; not inflated; flattened; without beak; rounded at apex; apex right-angled or more with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible. Fruit margin constricted or not constricted; constricted only on 1 margin; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 8–13 mm long; widest across seed area; with all essentially similar in shape; D-shaped (to galeiform). Epicarp dull; monochrome; reddish brown; pubescent and indurate; with 1 type of pubescence; villous; with pubescence gray; with pubescence uniformly distributed; with simple and glandular hairs (the simple hairs longer than the glandular ones); stiff and pliable; with hair bases plain; with glandular hairs; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Seeds 1 or 2; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only. Aril absent.

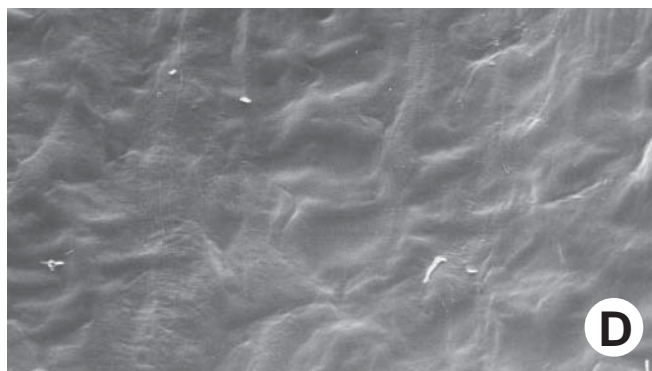
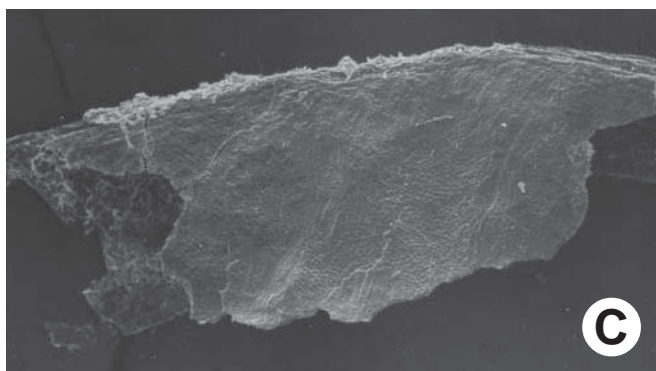
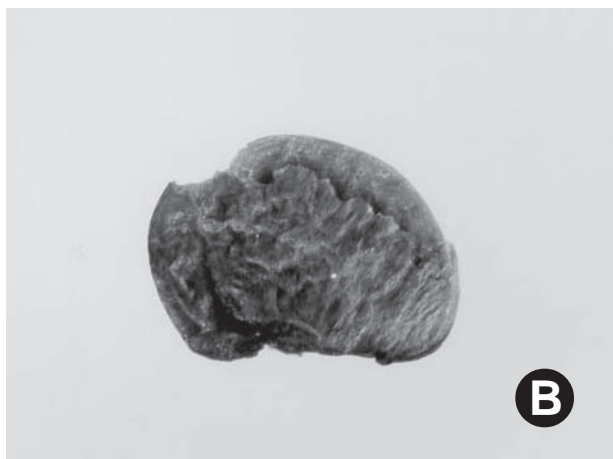
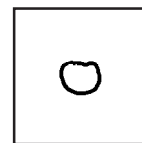
Seed ca. 5.5 mm long; ca. 4 mm wide; ca. 1 mm thick; not overgrown; not angular; asymmetrical; reniform; flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces; without medial ridge on each face. Cuticle not exfoliating; not inflated; not wrinkled. Testa without pieces of adhering epicarp; not adhering to endocarp; free from endocarp; dull; not modified by a

bloom; colored; monochrome; reddish brown; glabrous; smooth; chartaceous. Pseudopleurogram absent. Fracture lines absent. Rim absent. Wing(s) absent. Raphe not visible. Hilum fully concealed; concealed by aril remnant; with faboid split (assumed); larger than punctiform; ca. 0.4 mm long; with straight outline; linear; flush; not within corona, halo, or rim. Lens discernible; ca. 0.3 mm long; with margins straight; linear; not in groove of raphe; adjacent to hilum; ca. 0.2 mm from hilum; flush; dissimilar color from testa; black; not within corona, halo, or rim.

Distribution: Brazil.

Notes: Bailey et al. (1997), using the chloroplast *rpl2* intron and ORF184, suggested that *Cranocarpus* is not a member of Desmodieae and that it belongs in Aeschynomeneae. Harley (1978) monographed *Cranocarpus* (with two species), and Fernandes and Bezerra (1979) named a new species. According to Harley (1978), *C. mezii* P.H.W. Taubert has one- or two-seeded fruits that are loment, and *C. martii* has one-seeded fruits by abortion of the lower ovule. The fruits of *C. martii* are homologous to those of *C. mezii*, and therefore are one-seeded loment. We had only one misshapen seed and one fruit for study.

Cranocarpus: *C. martii* G. Bentham (A–D). A, Fruit (× 3.7); B, seed (× 8.4); C–D, testa (× 50, × 1000).



Genus: *Arthroclianthus* H.E. Baillon

Phylogenetic Number: 11.03.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 13 spp.—ca. 10 spp.

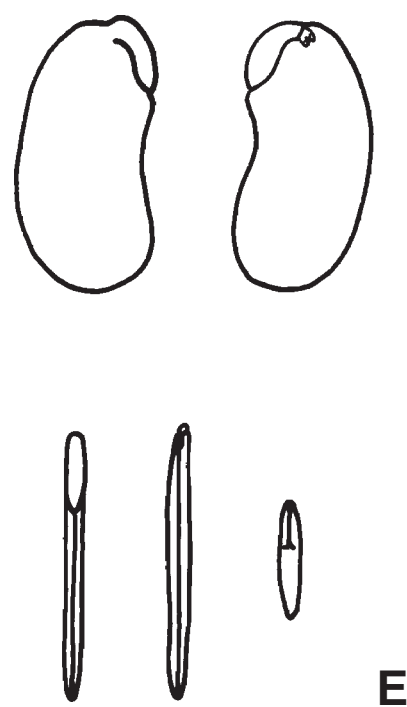
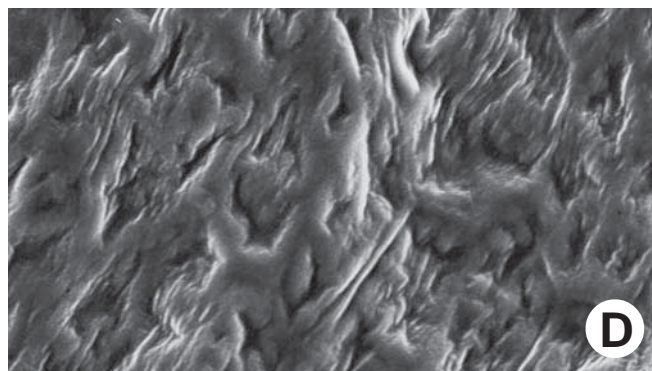
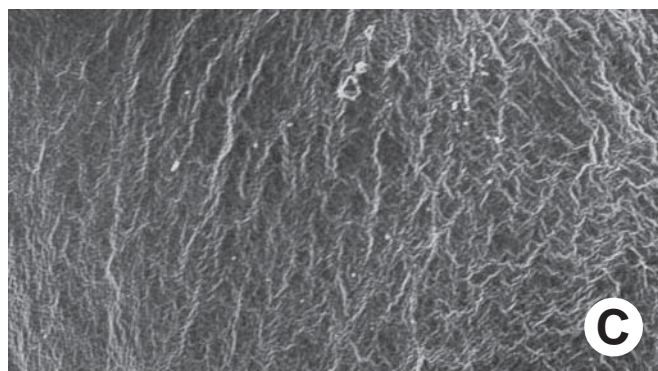
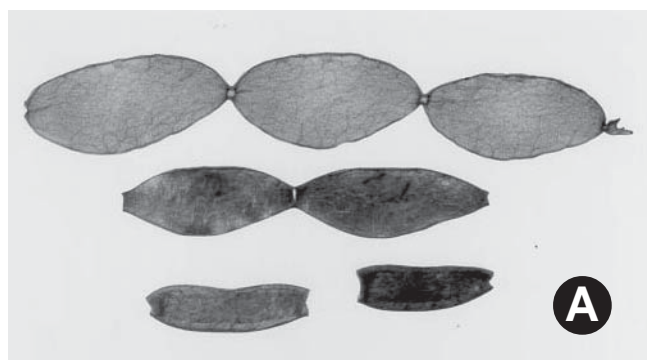
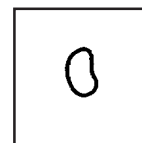
Fruit a loment (or loment segment); $8-14 \times 0.5-1.2 \times 0.1-1.15$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; moniliform (some with elongated isthmuses) or linear; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; narrowing in several places, resembling *Desmodium* (11.09) fruit; not inflated; flattened; with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit stipitate; with the stipe 14–40 mm long. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 14–35 mm long; widest across seed area; with all essentially similar in shape; D-shaped or oblong. Epicarp dull; monochrome; greenish brown to brown; pubescent and indurate or glabrous; with 1 type of pubescence; pilose; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface uniformly veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp glossy; monochrome; greenish tan; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 4–9; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; triangular; straight. Aril absent.

Seed $7-9 \times 4-4.5 \times 0.4-0.5$ mm; not overgrown; not angular; asymmetrical; reniform (sub-); flattened; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe from hilum to lens (near base of seed); not bifurcating; darker than testa; dark reddish brown; raised. Hilum fully concealed; concealed by funicular remnant; without faboid split; punctiform; marginal according to radicle tip; flush; within rim. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; adjacent to hilum; 2.5 mm from hilum (length of raphe); mounded; similar color as testa; darker than testa; dark reddish brown; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: New Caledonia.

Notes: Hochreutiner (1907) monographed the genus, and Ohashi et al. (1981) noted that *Arthroclianthus* is scarcely distinct from *Nephrodesmus* (11.04). We are unable to ascertain which of about ten species Ohashi et al. recognized.

Arthroclianthus: *A. pseudo-malaccensis* E. Vieillard ex A.T. Brongniart & J.A.A. Gris (C–E), *A. spp.* (A–B). A, Fruit segments and articles ($\times 1$); B, seeds ($\times 6.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



Genus: *Nephrodesmus* A.K. Schindler

Phylogenetic Number: 11.04.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 0 spp.—6 spp.

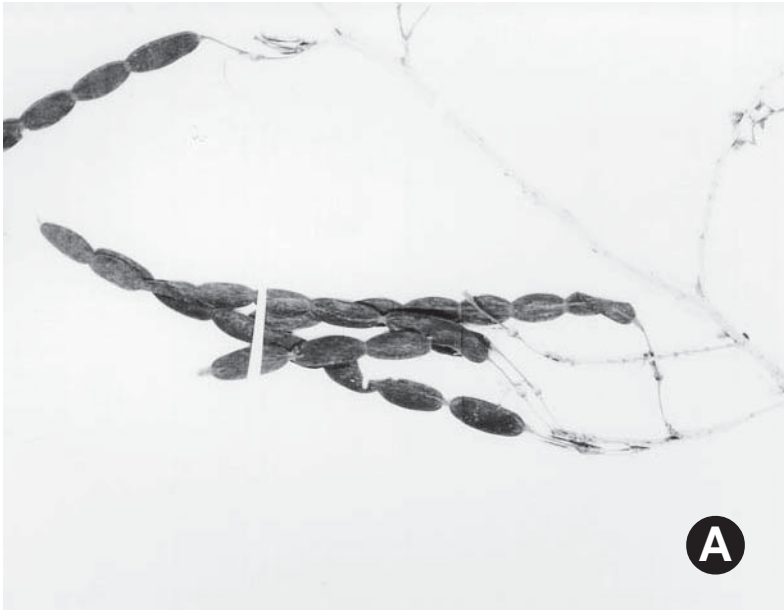
Fruit a loment (or loment segment); up to 15×0.7 – 0.85×0.1 – 0.4 (assumed) cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; moniliform; when asymmetrical with both sutures parallelly curved; not inflated; flattened; without or with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; rounded at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; membranous or chartaceous (both assumed); seed chambers externally visible. Fruit margin constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit stipitate; with the stipe 10–15 mm long. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 15–20 mm long; widest across seed area; with all essentially similar in shape; oblong. Epicarp dull; monochrome; greenish brown or green; pubescent and indurate; with hairs appressed; with 1 type of pubescence; with pubescence reddish brown; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; longitudinally veined relative to fruit length (assumed); not tuberculate; not exfoliating; without cracks. Mesocarp present or absent (assumed to be like *Desmodium* (11.09)). Endocarp septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 8–9; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only.

Distribution: New Caledonia.

Notes: Ohashi et al. (1981) noted that *Nephrodesmus* is scarcely distinct from *Arthroclianthus* (11.03). Neither seeds nor fruits were available for study. The only materials available for study were a xeroxed herbarium sheet labeled *N. sericeus* (B.P.G. Hochreutiner) A.K. Schindler collected by S.-R. Lenormand (2941), New

Caledonia (Royal Botanic Gardens, Kew) and *N. albus* collected by B. Balansa (2808), New Caledonia (The Natural History Museum (London)). Another sheet of *M. balansa* (Royal Botanic Gardens, Kew) was studied from a colored photograph.

Nephrodesmus: *N. albus* A.K. Schindler (A). A, Fruits from a colored photograph of a specimen collected by M. Balansa 2808 New Caledonia and accessioned at Kew ($\times 0.6$).



Genus: *Trifidacanthus* E.D. Merrill

Phylogenetic Number: 11.05.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a loment (or loment segment); $2.8-6 \times 0.5-0.7 \times 0.055-0.057$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; moniliform; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; narrowing in several places, resembling *Desmodium* (9.09) fruit; not inflated; flattened; with beak; straight or declined; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted on 1 margin and slightly constricted on the other margin; without sulcus; plain. Fruit wings absent. Fruit stipitate; with the stipe 9–25 mm long. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 2.5–10 mm long; widest across seed area; with all essentially similar in shape; D-shaped, oblong, or quadrangular. Epicarp dull; monochrome; brown or tan; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; reddish brown; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 3–8; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; triangular; straight. Aril dry; rim-aril; reddish brown.

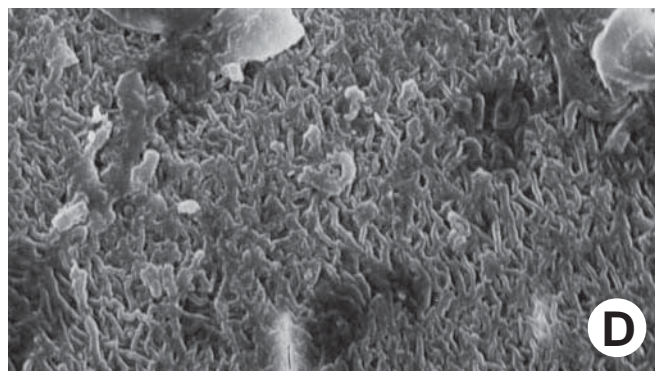
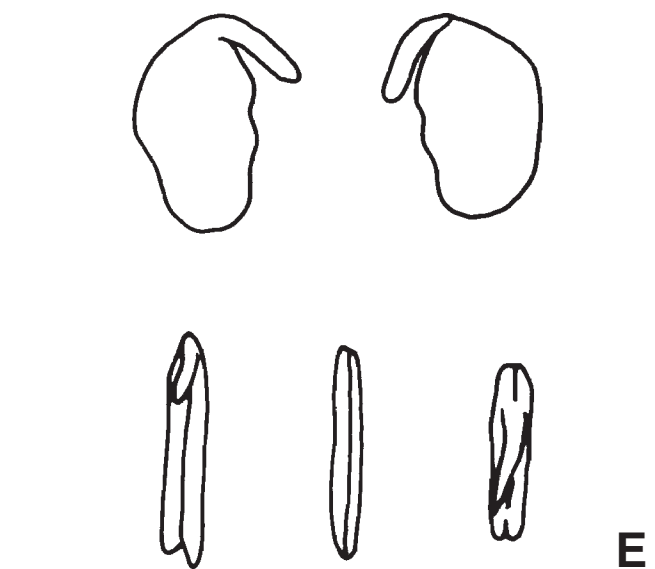
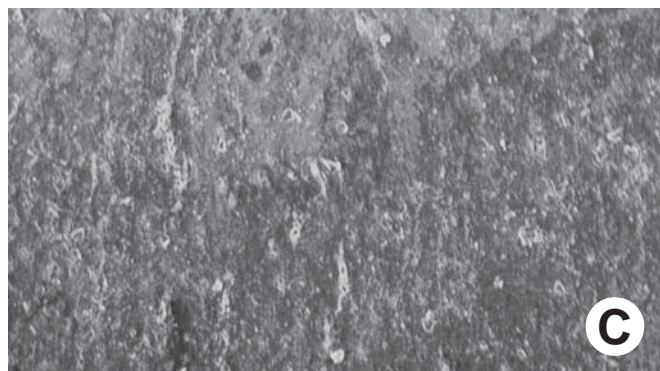
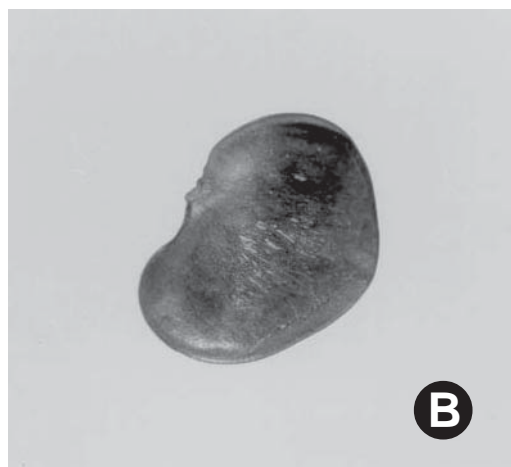
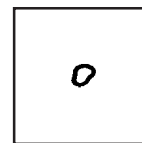
Seed $2-4.5 \times 1-1.4 \times 0.7-0.8$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces.

Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.4 mm long; with curved outline; elliptic; marginal according to radicle tip or between cotyledon and radicle lobe; recessed; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length or equal to or greater than 0.5 mm in length; 0.5 mm long; with margins straight; linear; not in groove of raphe; confluent with hilum; recessed; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; inner face flat. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; lobe tip straight; oblique to cotyledons; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary.

Distribution: Vietnam, Hainan, Philippines, and Lesser Sunda Islands.

Notes: Merrill (1917) founded the genus without seeing fruits; 2 years later he described the fruits (Merrill 1919). Ohashi et al. (1996) revised the genus and concluded that it is a distinct, monotypic genus in tribe Desmodieae.

Trifidacanthus: *T. unifoliolatus* E.D. Merrill (A–E). A, Fruit (immature and nearly entire) and article (mature) ($\times 3$); B, seed ($\times 7.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 7$).



Genus: *Dendrolobium* (R. Wight & G.A.W. Arnott) G. Benth

Phylogenetic Number: 11.06.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 11 spp.—13 spp.

Fruit a loment (or loment segment) or legume; unilocular; $0.9\text{--}4.5 \times 0.5\text{--}0.85 \times 0.12\text{--}0.3$ cm; with deciduous calyx; without orifice formed by curving of fruit or fruit segments; slightly curved, straight, or curved; not plicate; not twisted; asymmetrical; moniliform, linear, or falcate (sub-); when asymmetrical with both sutures parallelly curved or 1 straight and 1 curved suture; narrowing in several places, resembling *Desmodium* (11.09) fruit; not inflated; compressed or flattened; with or without beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned with longitudinal axis of fruit; short tapered or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; ligenous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted along both margins; without sulcus; plain. Fruit substipitate or nonstipitate. Fruit indehiscent. Replum invisible. Loment an intact article; indehiscent. Loment segments (articles) inconspicuous; 7–8 mm long; widest across seed area; with all essentially similar in shape; D-shaped or quadrangular. Epicarp dull; monochrome; reddish brown; pubescent and indurate, glabrous, or glabrate; with hairs appressed or erect; with 1 type of pubescence; tomentose; with pubescence golden; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined or reticulately veined (*D. dispersum* (B. Hayata) A.K. Schindler and *D. rostratum* (A.K. Schindler) A.K. Schindler); not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp thick; surface not veined; 1- or 2-layered; without balsamic vesicles; without fibers; solid; with honeycomb layer over solid layer; ligenous. Endocarp glossy; monochrome; tan (to reddish); smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–8; length parallel with fruit length; neither overlapping nor

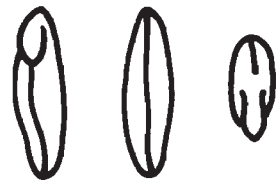
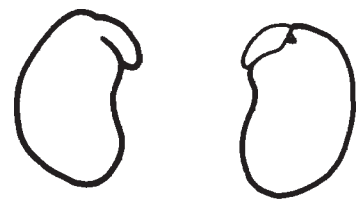
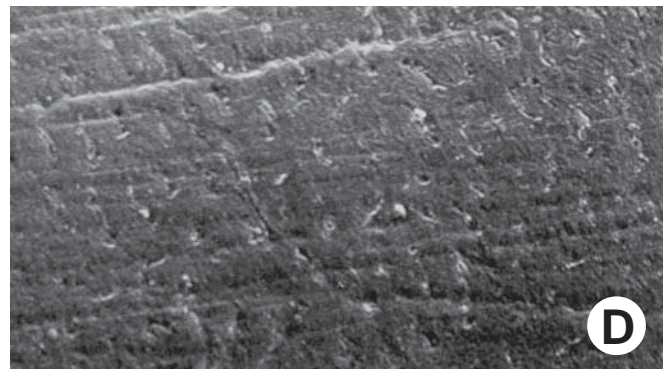
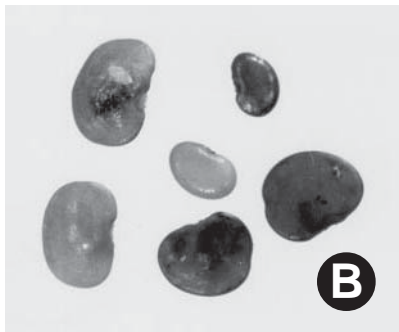
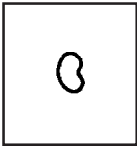
touching; in 1 series. Funiculus measured or less than 0.5 mm long; 0.5 mm long; of 1 length only; thick; straight. Aril absent.

Seed $3\text{--}3.6 \times 2\text{--}2.8 \times 1\text{--}1.6$ mm; not overgrown; not angular; asymmetrical; oblong, ovate, elliptic, or quadrangular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without or with umbo on seed faces; with umbo on both faces of seed. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or fully concealed; concealed by funicular remnant; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip; recessed; within rim. Hilum rim color of testa. Lens discernible; less than 0.5 mm in length or equal to or greater than 0.5 mm in length; 0.5 mm long; with margins straight or curved; triangular or linear; 2 circular mounds separated by groove; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; dark reddish brown; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa or adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear or bulbous; deflexed and parallel to cotyledon length or width; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed or rudimentary; glabrous.

Distribution: Tropical Asia, Australia, and Indian Ocean coastal region.

Notes: Ohashi (1973) monographed the genus and provided illustrations of fruits and seeds. He (Ohashi 1997b,c) also reviewed the species of Malesia, Australia, and Fiji and *D. cumingianum* G. Benth.

Dendrolobium: *D. lanceolatum* (S.T. Dunn) A.K. Schindler (C–E), *D. spp.* (A–B). A, Fruit segment and articles ($\times 2.3$); B, seeds ($\times 2.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 5$).



E

Genus: *Phyllodium* A.N. Desvaux

Phylogenetic Number: 11.07.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 6 spp.—6 spp.

Fruit a loment (or loment segment) or legume; unilocular; $0.4\text{--}4 \times 0.3\text{--}0.4 \times 0.1\text{--}0.15$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (or slightly curved); not plicate; not twisted; asymmetrical; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; flattened; with beak; straight or coiled; with solid beak the same color and texture as fruit; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; short tapered or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted on 1 margin and slightly constricted on the other margin; without sulcus; plain or embellished; with fringe (of hair). Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 3–4 mm long; widest across seed area; with upper and lower 1 different shape than middle ones; D-shaped or quadrangular. Epicarp dull; monochrome; reddish brown; pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; pilose; with pubescence golden or gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; monochrome or mottled and streaked (area below seed somewhat streaked and mottled to lighter colored); reddish brown or tan (reddish); with mottling over seed chambers; with brown (reddish) or tan (reddish) overlay; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–9; length transverse to fruit length; neither overlapping nor

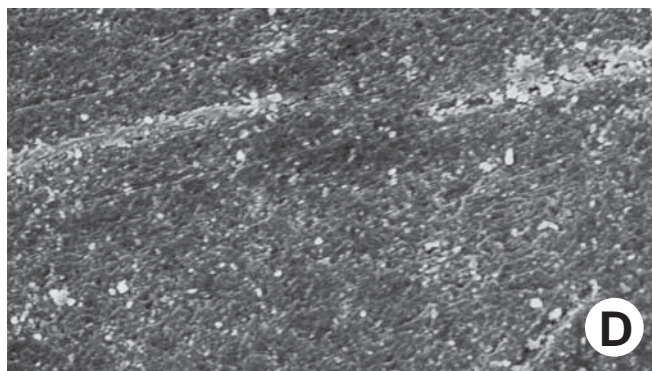
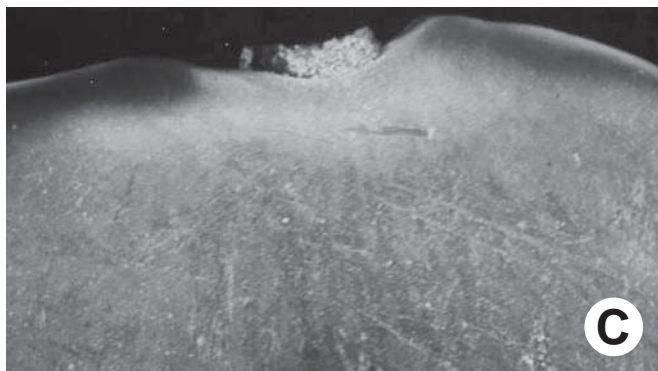
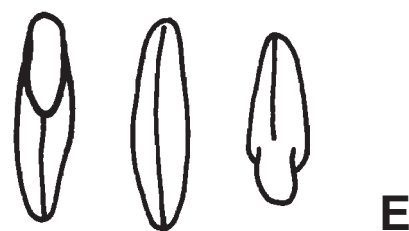
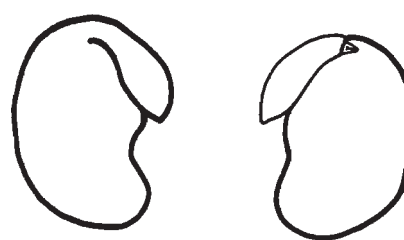
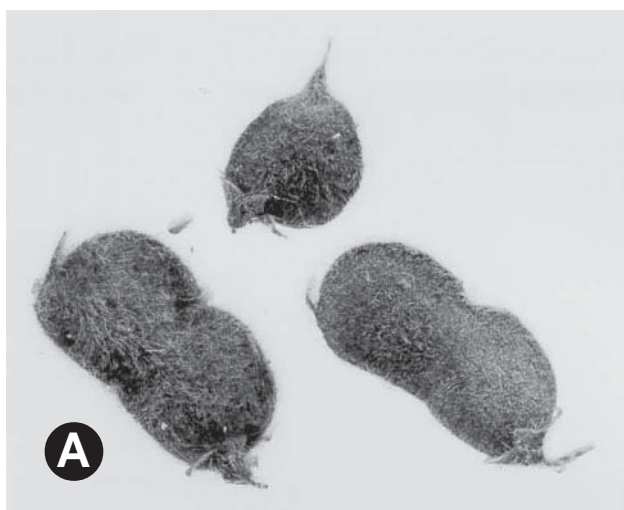
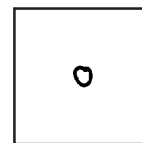
touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened; straight. Aril dry; rim-aril; tan.

Seed $2.2\text{--}4 \times 1.8\text{--}3 \times 1$ mm; not overgrown; not angular; symmetrical or asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome; reddish brown or tan; glabrous; smooth; chartaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform or punctiform; 0.5 mm long; with curved outline; circular; marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length; with margins straight or curved; linear or wedge-shaped; circular; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; black or tan (reddish); not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white or tan (to nearly white); inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Southern Asia and northern Australia.

Notes: Ohashi (1973) monographed the genus and provided a wider range of fruit and seed characters than our plate.

Phyllodium: *P. pulchellum* (C. Linnaeus) A.N. Desvaux (C–E), *P. spp.* (A–B). A, Fruits (1- and 2-seeded) ($\times 5$); B, seeds ($\times 6.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



Genus: *Aphyllodium* (A.-P. de Candolle) F. Gagnepain

Phylogenetic Number: 11.08.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 1 sp.—4 spp.

Fruit a loment (or loment segment) or legume; $0.2\text{--}1.7 \times 0.3\text{--}0.35 \times 0.12\text{--}0.15$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; elliptic or moniliform; not inflated; flattened; with beak; straight; with solid beak the same color and texture as fruit; tapered, rounded, or truncate (if lower of two articles) at apex; apex aligned or oblique with longitudinal axis of fruit; short tapered or truncate (if upper article of two) at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 3.5–4 mm long; widest across seed area; with all essentially similar in shape; elliptic. Epicarp dull; monochrome; reddish brown; pubescent and indurate; with hairs appressed or erect; with 1 type of pubescence; velutinous; with pubescence gray; with pubescence uniformly distributed; with simple hairs; stiff; with hair bases plain; antrorse; straight at apex; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp glossy; monochrome; tan; smooth; septate or nonseptate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 2 or 1; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened or triangular; straight. Aril present (easily knocked off); dry; rim-aril; greenish tan or green.

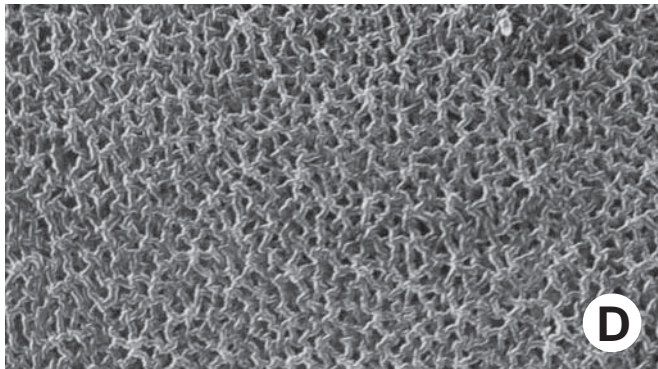
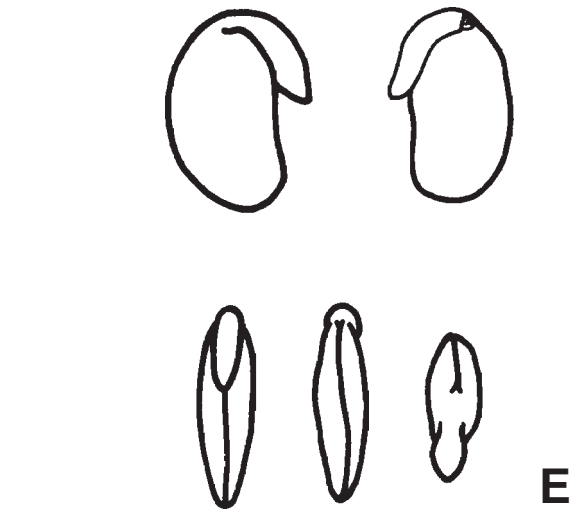
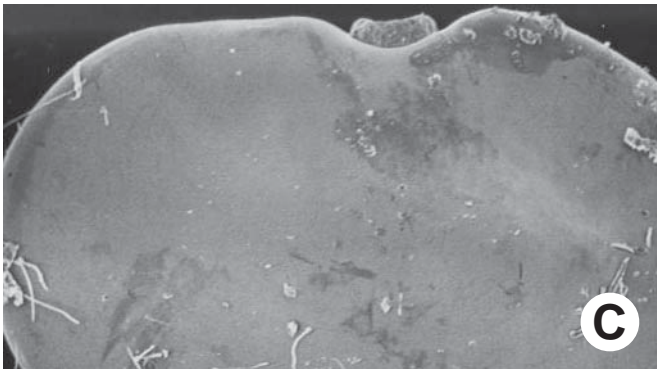
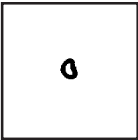
Seed $1.2\text{--}1.5 \times 1\text{--}1.2 \times 1\text{--}1.1$ mm; not overgrown; not angular; asymmetrical; oblong; compressed; with surface smooth; with or without visible radicle and

cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; with umbo on both faces of seed. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome or mottled and streaked; greenish tan, green, or purple; with purple overlay (more frequent than background color); glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform (much smaller and much less conspicuous than the darker lens on greenish seeds); between cotyledon and radicle lobe; recessed; not within corona, halo, or rim or within halo. Hilum halo color of testa (but not mottled with purple). Lens discernible (greenish seeds) or not discernible (purplish seeds); less than 0.5 mm in length; with margins straight or curved; square; 2 circular mounds separated by groove; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; reddish brown; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow or green; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical Asia to Australia.

Notes: Ohashi (1997a) corrected the name of this genus from *Dicerma* A.-P. de Candolle to *Aphyllodium* and defined its species more narrowly so that it has four species, the count we used. He (Ohashi 1973) also provided excellent drawings of fruits and seeds of the three species when treated as *Dicerma*.

Aphyllum: *A. biarticulatum* (C. Linnaeus) F. Gagnepain (A–E). A, Fruits (1- and 2-seeded: 1-seeded with calyx and petal) ($\times 6.8$); B, seeds ($\times 10$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



Genus: *Desmodium* A.N. Desvaux

Phylogenetic Number: 11.09.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 69 spp.—ca. 300 spp.

Fruit a loment (or loment segment) or legume; unilocular; $0.8\text{--}5 \times 0.08\text{--}2.5 \times 0.02\text{--}0.09$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight, curved (or slightly curved), or contorted; not plicate or plicate (*D. styracifolium* (P. Osbeck) E.D. Merrill plicate when young and becoming straight with age); not twisted or twisted; symmetrical or asymmetrical; linear, circular (with notch at funiculus), dolabriform, irregular, or samaroid; when asymmetrical with 1 straight and 1 curved suture, both sutures parallelly curved, or both sutures unequally curved; narrowing in several places; not inflated or inflated; flattened or compressed; without or with beak; with solid beak the same color and texture as fruit; rounded or short tapered at apex; apex aligned or oblique with longitudinal axis of fruit; short tapered, tapered, or long tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous, coriaceous, or chartaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted or not constricted; constricted on 1 margin and slightly constricted on the other margin, slightly constricted only on 1 margin, constricted only on 1 margin, or slightly constricted along both margins; without sulcus; plain or embellished; with prickles (at least stiff, usually hooked hairs). Fruit wing 1; up to 10 mm wide; samaroid; on 1 suture. Fruit substipitate or stipitate; with the stipe 1–20 mm long. Fruit indehiscent or with all layers dehiscing (tardily); splitting along suture. Dehiscence of valves along 1 suture; medial and up and down; passive. Replum invisible (most spp.) or visible (at least 1 sp. in Panama (Schubert 1980)). Loment indehiscent (most spp.) or dehiscing along 1 suture (few spp., especially spp. in subtribe *Sagotia*). Loment segments (articles) inconspicuous; 2–30 mm long; widest across seed area; with all essentially similar in shape; D-shaped, triangular, curved, quadrangular, or circular (with notch at funiculus more or less dolabriform). Epicarp dull; monochrome or multicolored; mottled; brown (various shades and combinations, especially reddish) or tan (to

greenish); with brown (reddish) or purple overlay; glabrate or glabrous; with hairs erect or appressed; with 1 or 2 types of pubescence; pilose, puberulent, or velutinous; with pubescence golden, brown, yellow, or gray-brown; with golden hooked hairs and gray plain hairs; with pubescence uniformly distributed; with simple hairs (plain and hooked hairs mixed, plain hairs, or hooked hairs); pliable or stiff; with hair bases plain; straight, retrorse, or antrorse; hooked or straight at apex; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; wrinkled; not exfoliating; without cracks. Mesocarp present or absent; thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous or coriaceous. Endocarp glossy or dull; monochrome; tan; spongy; with hairs in longitudinal rows (*D. auricomum* R. Graham); septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–12; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long or measured; up to 4 mm long; of 1 length only; thick, flattened, or filiform; straight, curved, or S-curved. Aril present or absent; dry; rim-aril or cupshaped (only *D. microphyllum* (C.P. Thunberg) A.-P. de Candolle); entire; covering less than 1/2 of seed.

Seed $0.7\text{--}12.5 \times 0.5\text{--}5 \times 0.5\text{--}1$ mm; not overgrown; not angular; asymmetrical; D-shaped, oblong, quadrangular, rectangular, reniform, or linear; flattened or compressed; with surface grooved (*D. oojeinensis* (W. Roxburgh) H. Ohashi) or smooth; with grooves longitudinal and oblique; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull or glossy; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; with frequent streaks; dark to light reddish to brown, tan, green, or olive (green); with brown (dark reddish) overlay; glabrous; smooth or not smooth; with elevated or recessed features; faintly wrinkled; pitted with small separate pits; chartaceous or coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or fully concealed; concealed by funicular remnant; with or without faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform or larger than punctiform; up to 1 mm long; with curved or straight outline; circular, oblong, or linear; marginal according to radicle tip or between cotyledon and radicle lobe; recessed; within

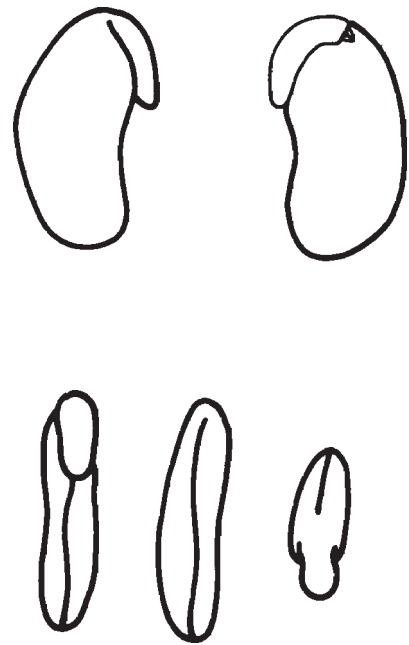
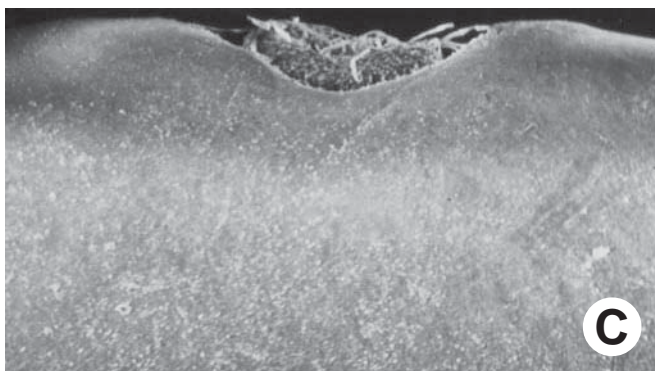
rim or not within corona, halo, or rim. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm in length or equal to or greater than 0.5 mm in length; up to 0.5 mm long; with margins straight or curved; circular, oblong, elliptic, or 2 circular mounds separated by groove; not in groove of raphe; confluent with hilum; flush; dissimilar color from testa; darker than testa; reddish brown, black, or yellow (reddish); not within corona, halo, or rim. Endosperm present or absent; thin; covering entire embryo; adnate to testa or embryo. Cotyledons smooth or not smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow, tan, or green; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed, well developed, or rudimentary; glabrous.

Distribution: Worldwide.

Notes: Several regional or country treatments were reviewed: Schubert (1980), Panama; Oliveira (1983, 1990), Brazil; Verdcourt (1974), Zambia; Schubert (1952, 1954), Congo; Ohashi (1973), Asia; and Ohashi (1988), Hawaii. Verdcourt (1977) synonymized *Papilionopsis* C.G.G.J. van Steenis with *Desmodium*, and Ohashi (1982b) transferred *Murtonia* W.G. Craib to *Desmodium* as a subgenus. Although most species of *Desmodium* have indehiscent lomentaceous fruits, a few species have dehiscent loment, especially in the subgenus *Sagatia* (O.P. Swartz) A.-P. de Candolle, *D. heterophyllum* (C.L. von Willdenow) A.-P. de Candolle and *D. microphyllum* (C.P. Thunberg) A.-P. de Candolle. *Desmodium auricomum* loment has a longitudinal band of dense hairs on the lateral surfaces. All species of *Desmodium* except one, *D. microphyllum*, have small, dry rim-arils (Ohashi 1973); *D. microphyllum* has small, dry, cupshaped arils (Ohashi 1973).

Desmodium: *D. uncinatum* (N. von Jacquin) A.-P. de Candolle (*C–E*), *D. spp.* (*A–B*). *A*, Fruits, partial fruits, and articles ($\times 1.9$); *B*, seeds ($\times 3.4$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 10$).

0



Genus: *Codariocalyx* J.C. Hasskarl

Phylogenetic Number: 11.10.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 2 spp.—2 spp.

Fruit a legume (resembling a loment); unilocular; $0.7\text{--}5 \times 0.3\text{--}0.7 \times 0.18\text{--}0.2$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; curved (or slightly curved); not plicate; not twisted; asymmetrical; linear (with toothed lower suture); when asymmetrical with 1 straight and 1 curved suture or both sutures nearly straight; narrowing in several places, resembling *Desmodium* (11.09) fruit (false loment); not inflated; flattened; without beak; rounded at apex; apex oblique or aligned with longitudinal axis of fruit; short tapered or rounded at base; base oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers torulose. Fruit margin constricted only on 1 margin; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscent; splitting along suture (lower). Dehiscence of valves along 1 suture (lower margin); passive. Replum invisible. Epicarp dull; monochrome; dark reddish brown; pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; pilose or tomentose; with pubescence golden (hook tipped) and gray (plain tipped); with pubescence uniformly distributed; with simple hairs (shorter gray plain tipped, longer yellow hooked tipped); with hair bases plain; eglandular; without spines; smooth; not veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull or glossy; monochrome; reddish tan or brown (reddish); smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–13; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; flattened or triangular; straight. Aril fleshy; cupshaped (with undulate margin); covering less than 1/2 of seed; tan.

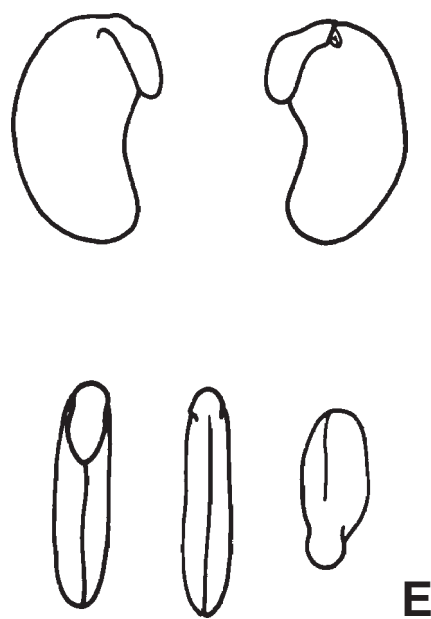
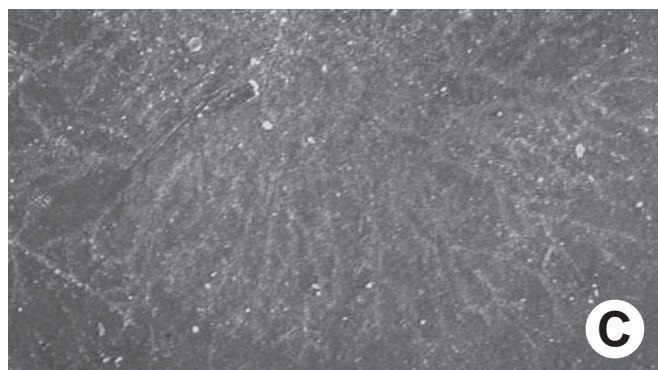
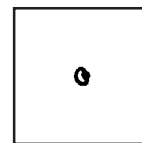
Seed $2.5\text{--}4.5 \times 2.5\text{--}4 \times 1.5\text{--}1.7$ mm; not overgrown; not angular; asymmetrical; elliptic or reniform; com-

pressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; with umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; with frequent streaks; reddish brown; with black overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible or partially concealed; concealed by aril; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 1 mm long; with straight outline; oblong; marginal according to radicle tip; recessed; not within corona, halo, or rim. Lens not discernible. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; yellow; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle bulbous; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Southeastern Asia and tropical Australia.

Notes: Ohashi (1973) monographed the two species and provided fruit and seed illustrations. The multiseeded legumes of *Codariocalyx* have persistent septa between the seed compartments, so that the fruit appears to be a loment. It dehisces along the lower suture releasing the seeds from the individual seed compartments. The dehiscent fruit is a line of open individual seed compartments which continue to be joined by the upper suture.

Codariocalyx: *C. gyroides* (W. Roxburgh ex J.H.F. Link) J.K. Hasskarl (C–E), *C. spp.* (A–B). A, Fruits ($\times 2$); B, seeds ($\times 7.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



Genus: *Pseudarthria* R. Wight & G.A.W. Arnott

Phylogenetic Number: 11.11.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 3 spp.—4–6 spp.

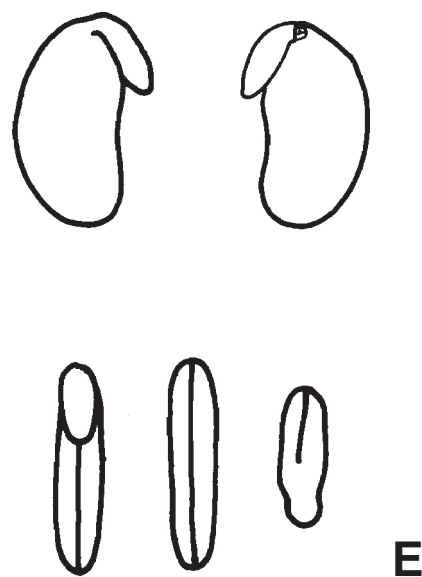
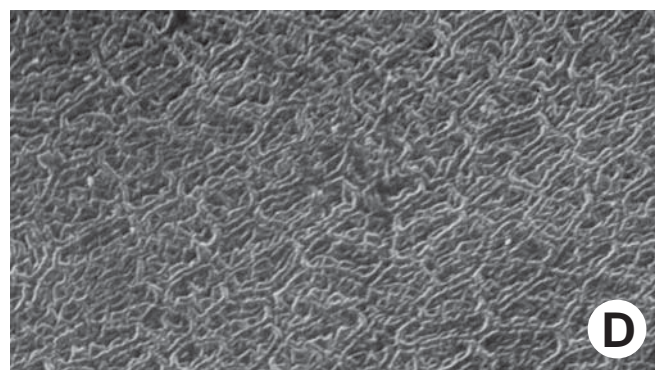
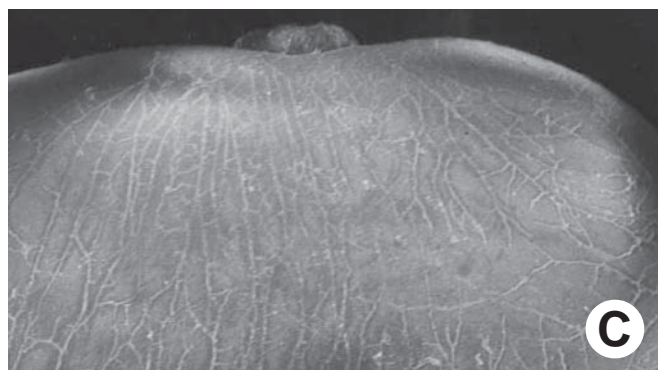
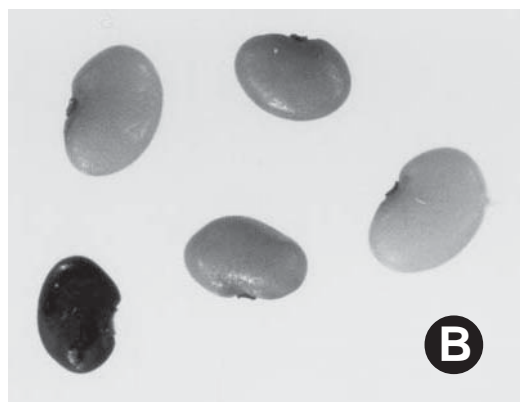
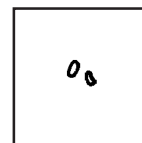
Fruit a legume; unilocular; $1.3\text{--}2 \times 0.3\text{--}0.5 \times 0.1\text{--}0.13$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; oblong; when asymmetrical with both sutures nearly straight; not inflated; flattened; with or without beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base oblique or aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally invisible or visible (faintly); with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscing; splitting along suture. Dehiscence of valves along 1 suture; apical and down (assumed); active; with valves reflexing. Replum invisible. Epicarp dull; monochrome; dark reddish brown; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden (*P. viscida* (C. Linnaeus) R. Wight & G.A.W. Arnott with hooked-tipped hairs) or gray (*P. hookeri* without hooked-tipped hairs or *P. fagifolia* J.G. Baker with straight- and hooked-tipped hairs); with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; not veined or transversely veined relative to fruit length and reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous (sub-). Endocarp dull; monochrome; reddish brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 5–8; length transverse or oblique to fruit length; touching; in 1 series. Funiculus measured; 10 mm long; of 1 length only; filiform; S-curved or curved. Aril dry; rim-aril; reddish brown.

Seed $2.5 \times 1.5 \times 1$ mm; not overgrown; not angular or angular; asymmetrical; reniform, oblong, triangular, or irregular; compressed; with surface smooth; without or

with visible radicle and cotyledon lobes; without or with external groove (faintly) between radicle and cotyledon lobes; with external groove between radicle and cotyledon lobes same color as testa; without hilar sinus; with umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown, tan (to greenish or reddish), black (*P. viscida*), or orange (seeds have been described as orange); glabrous; smooth (*P. hookeri* and *P. fagifolia*) or not smooth (*P. viscida*); with elevated features; shagreen; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip or between cotyledon and radicle lobe; barely recessed; not within corona, halo, or rim or within halo (faint). Hilum halo color of testa. Lens not discernible or discernible (faintly); less than 0.5 mm in length; with margins straight or curved; somewhat linear or triangular; not in groove of raphe; confluent with hilum; flush; similar color as or dissimilar color from testa; darker than testa; reddish brown or tan (greenish); not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Old World tropics.

Pseudarthria: *P. hookeri* R. Wight & G.A.W. Arnott (C–E), *P. spp.* (A–B). A, Fruits ($\times 4$); B, seeds ($\times 8.8$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



Genus: *Pycnospora* R. Brown ex R. Wight & G.A.W.
Arnott

Phylogenetic Number: 11.12.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 1 sp.—1 sp.

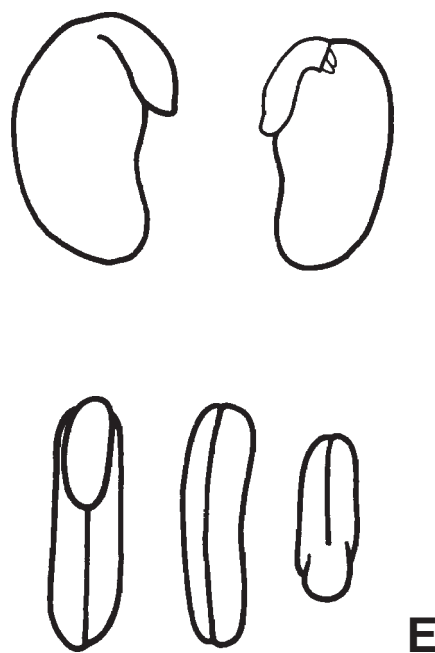
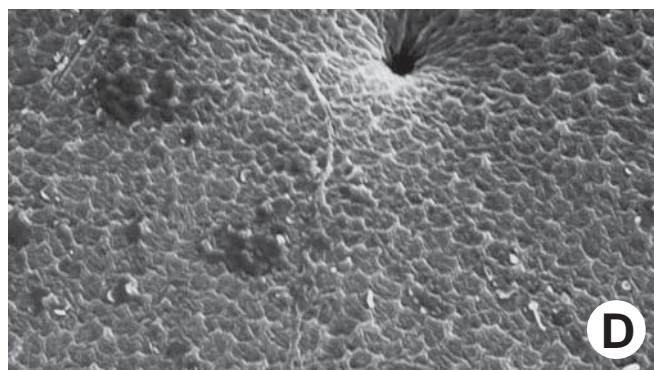
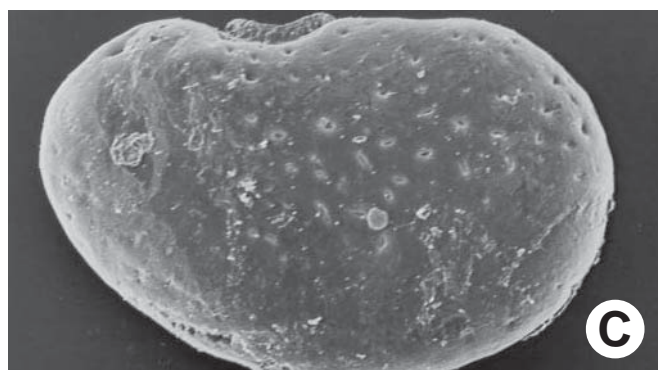
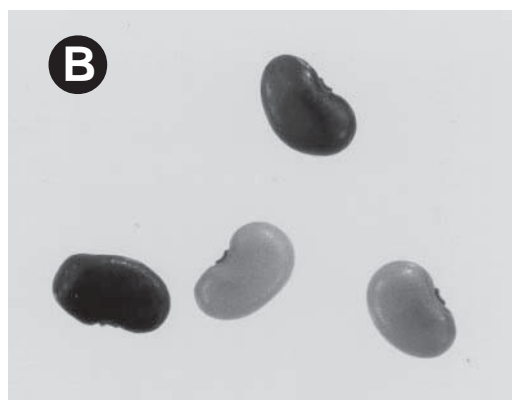
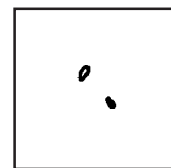
Fruit a legume; unilocular; $1-1.3 \times 0.5-0.6 \times 0.5$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; oblong; when asymmetrical with 1 straight and 1 curved suture or both sutures nearly straight; widest near middle or D-shaped; inflated; terete; without or with beak; straight or hooked; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally invisible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit with all layers dehiscent; splitting along suture. Dehiscence of valves along 1 suture; apical and down (assumed); passive. Replum invisible. Epicarp dull; monochrome or multicolored; mottled (large areas); blackish brown, tan (blackish), or black; with black overlay; pubescent and indurate; with 2 types of pubescence; puberulent; with pubescence golden or gray (and some hooked); with erect golden hairs and white hooked or not hooked hairs; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; transversely veined relative to fruit length and reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp very thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp glossy; monochrome; blackish brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 10; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; filiform; straight. Aril dry; rim-aril; dark reddish brown.

Seed $1-1.3 \times 0.8-1 \times 0.5$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes;

without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip; barely recessed; within halo. Hilum halo color lighter than testa. Lens discernible; less than 0.5 mm in length; with margins straight or curved; oblong; not in groove of raphe; adjacent to hilum; 0.1 mm from hilum; flush; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical Africa, India to Philippines, New Guinea, and northern Australia.

Pycnospora: *P. lutescens* (J.L.M. Poiret) A.K. Schindler (A–E). A, Fruits (dehiscent and closed) ($\times 4.6$); B, seeds ($\times 9.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 25$).



Genus: *Tadehagi* H. Ohashi

Phylogenetic Number: 11.13.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 1 sp.—4 spp.

Fruit a loment (or loment segment); $2.5\text{--}4.7 \times 0.45\text{--}0.7 \times 0.07\text{--}0.09$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical; moniliform; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; narrowing in several places, resembling *Desmodium* (11.9) fruit; not inflated; flattened; with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; short tapered at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted on 1 margin and slightly constricted on the other margin; without sulcus; plain. Fruit wings absent. Fruit stipitate, substipitate, or nonstipitate; with the stipe up to 14 mm long. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; $2.7\text{--}10$ mm long; widest across seed area; with upper and lower 1 different shape than middle ones; D-shaped, rectangular, or quadrangular. Epicarp dull; monochrome; brown to reddish or dark reddish brown; pubescent and indurate or glabrous (except for scattered hairs on suture); with 1 or 2 types of pubescence; pilose; with pubescence yellow; with long and short yellow hairs intermixed; with pubescence uniformly distributed; with simple hairs; longer stiff and pliable (shorter); with hair bases plain; antrorse; straight at apex; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; reddish brown; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 5–7; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; 2 mm long; of 1 length only; filiform; curved or straight. Aril dry; rim-aril; tan.

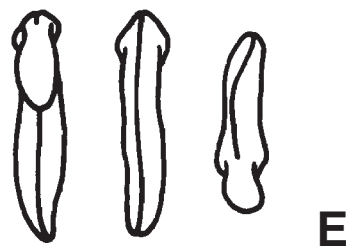
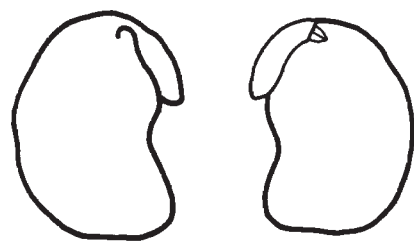
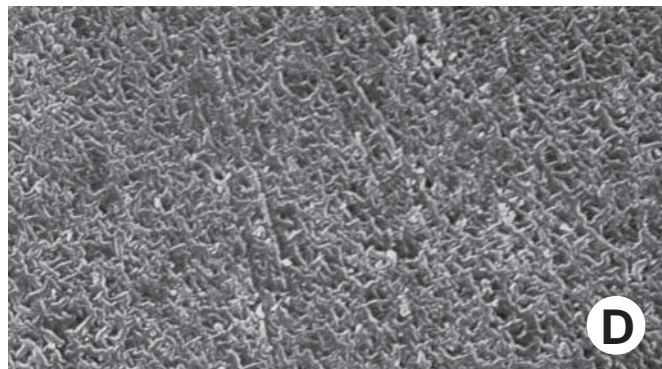
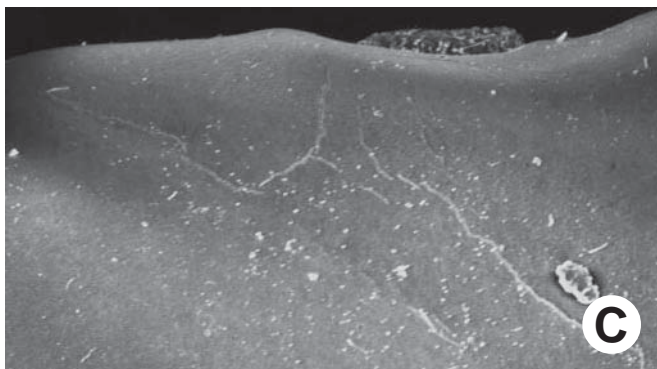
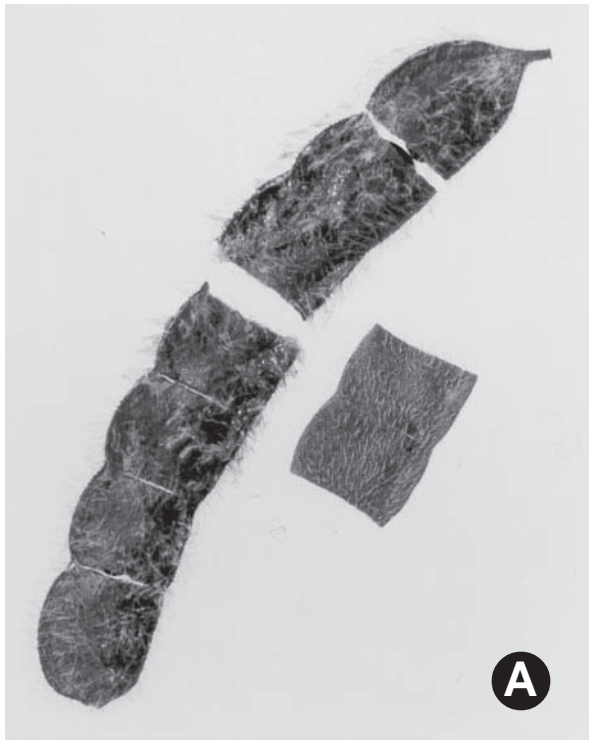
Seed $2.5\text{--}3.7 \times 2\text{--}2.5 \times 0.7\text{--}1.5$ mm; not overgrown; angular or not angular; asymmetrical; reniform or irregular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without or with umbo on seed faces; with umbo on 1 face of seed. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown, tan (to reddish or greenish), yellow, green, or orange; glabrous; smooth; coriaceous. Fracture lines present (easier to see on lighter colored seeds) or absent; reticulate. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5 mm long; with curved outline; circular; marginal according to radicle tip or between cotyledon and radicle lobe; recessed; not within corona, halo, or rim. Lens discernible; less than 0.5 mm in length; with margins curved; 2 oblong mounds separated by groove; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thick; covering entire embryo; adnate to testa. Cotyledons not smooth; both outer faces convex; both the same thickness; both more or less of equal length; with both folded; sufficiently folded for inner face to touch itself; portions of inner folded face unequal; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without or with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown or tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; with a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: India to southern China to New Caledonia and northern Australia.

Notes: Ohashi et al. (1981) noted that *Tadehagi* integrates with *Droogmansia* (11.14) and provided fruit and seed drawings of *Tadehagi*. Ohashi (1982a) and Maiti and Ghosh (1997) reevaluated *T. triquetrum* subsp. *rodgeri* (A.K. Schindler) H. Ohashi, and raised it to the rank of species, *T. rogeri* (A.K. Schindler) H. Ohashi. Therefore, there are four species in the genus.

Tadehagi: *T. triquetrum* (C. Linnaeus) H. Ohashi (A–E). A, Fruits (entire but separated and two united articles) ($\times 3.3$); B, seeds ($\times 7.6$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 11$).

3



Genus: *Droogmansia* E.A.J. De Wildeman

Phylogenetic Number: 11.14.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 2 spp.—ca. 10 spp.

Fruit a loment (or loment segment); $3.3\text{--}4 \times 0.3\text{--}0.7 \times 0.7\text{--}0.9$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved or straight; not plicate; not twisted; asymmetrical; moniliform; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; narrowing in several places, resembling *Desmodium* (11.09) fruit; not inflated; flattened; with beak; declined; with solid beak the same color and texture as fruit; rounded at apex; apex aligned or oblique with longitudinal axis of fruit; rounded at base; base aligned or oblique with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted or slightly constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit stipitate or substipitate; with the stipe up to 70 mm long. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 5–13 mm long; widest across seed area; with upper or lower 1 different shape than middle ones; D-shaped or circular. Epicarp dull; monochrome; dark reddish to light brown or tan; pubescent and indurate; with 1 type of pubescence; sericeous; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; veined or not veined; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; reddish brown; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 1–5; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus measured; up to 1 mm long; of 1 length only; flattened; straight. Aril absent.

Seed $2.5\text{--}4.5 \times 2.5\text{--}3 \times 1.3\text{--}1.5$ mm; not overgrown; not angular; asymmetrical; reniform or oblong; flattened; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome (but note hilar halo); dark reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5 mm long; with curved outline; elliptic; marginal according to radicle tip or between cotyledon and radicle lobe; flush; within halo. Hilum halo color darker (and irregular in outline) than testa. Lens discernible; less than 0.5 mm in length or equal to or greater than 0.5 mm in length; 0.3–0.8 mm long; with margins straight or curved; irregular, linear, or wedge-shaped; not in groove of raphe; confluent with hilum; mounded or recessed; dissimilar color from testa; darker than testa; dark reddish brown; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

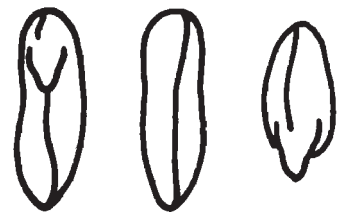
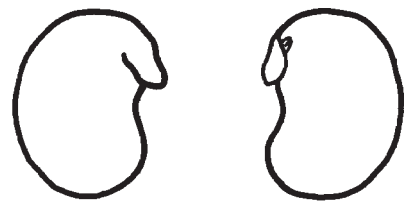
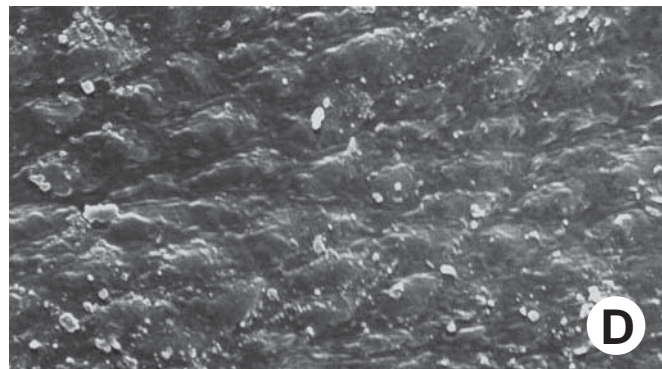
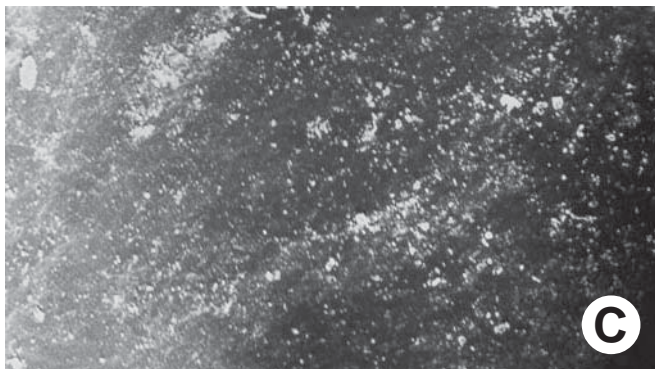
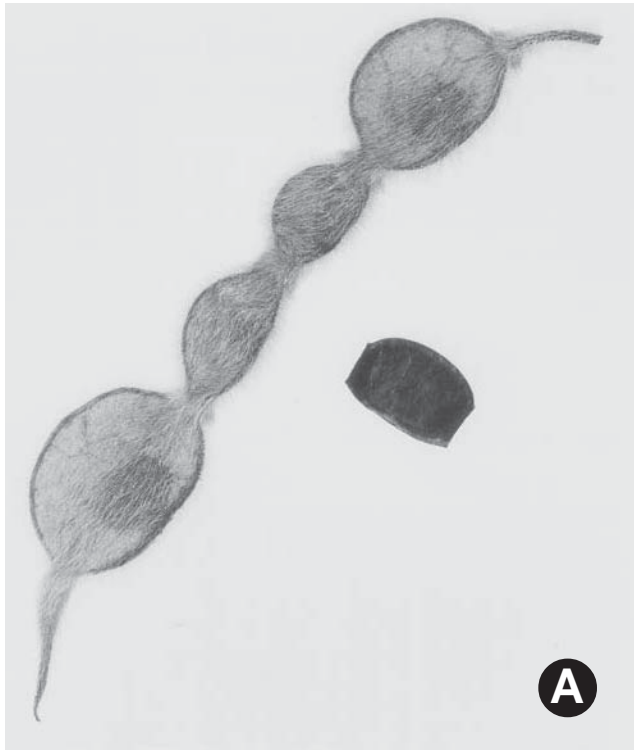
Distribution: South-central and West Africa and 1 sp. in Indochina.

Notes: Ohashi et al. (1981) noted that the number of species is “usually estimated to be about 30 species, but a single species complex in south-central Africa with perhaps a few distinct relatives, then four species in West Africa intergrading with *Tadehagi*” (11.13). We agree with Ohashi et al. (1981) and Verdcourt (1970b, 1974), but not Lock (1989), that there are only a few species in Africa, Lock’s recent list of 23 species in Africa notwithstanding. Schubert (1952) recognized nearly 30 species in Africa and noted that most of her new species were collected in flower. Our count of ca.

10 species is an estimate that may or may not be accurate. Regardless of the species counts, our fruit and seed material was quite limited.

Droogmansia: *D. pteropus* (J.G. Baker) E.A.J. De
Wildemann var. *whytei* (A.K. Schindler) B. Verdcourt
(*C-E*), *D. spp.* (*A-B*). *A*, Fruit and article ($\times 2.8$); *B*,
seeds ($\times 6.5$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos
($\times 6$).

6



E

Genus: *Mecopus* J.J. Bennett

Phylogenetic Number: 11.15.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; $0.27 \times 0.2 \times 0.1$ cm; with deciduous or persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped; not inflated; compressed; without beak; short tapered at apex; apex oblique with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit stipitate; with the stipe 50–60 mm long (and reflexed into “bird cage” where fruits are “caught”). Fruit with all layers dehiscing; splitting along suture. Dehiscence of valves along 1 suture; apical and down; passive. Replum invisible. Epicarp dull; monochrome; reddish brown or tan (reddish); pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; reddish brown or tan (reddish); smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1 or 2; length parallel with fruit length; neither overlapping nor touching (if 1-seeded); in 1 series. Funiculus less than 0.5 mm long; of 1 length only; straight. Aril dry; rim-aril; reddish brown.

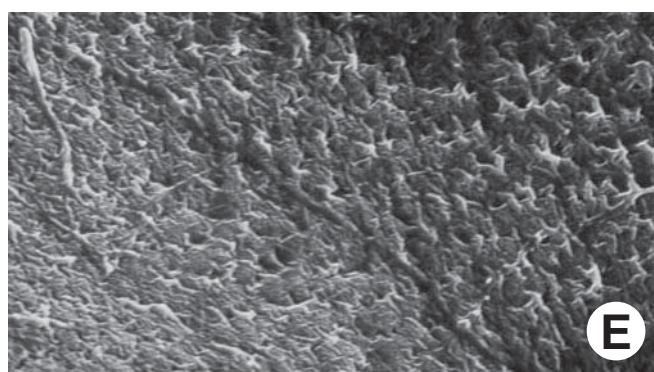
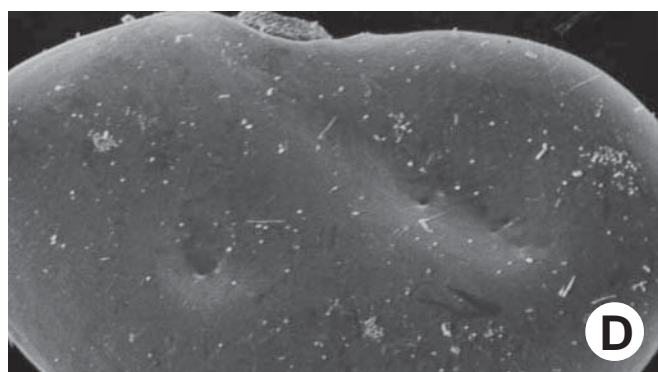
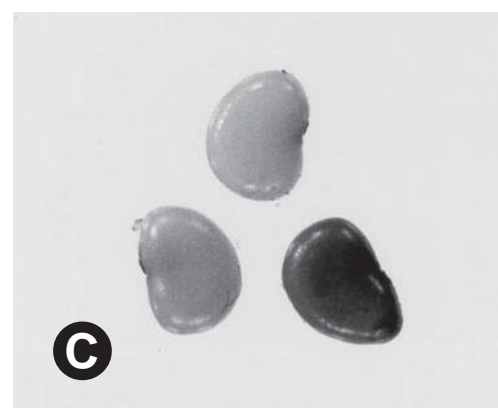
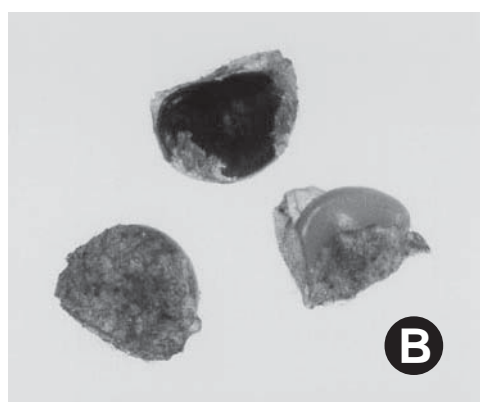
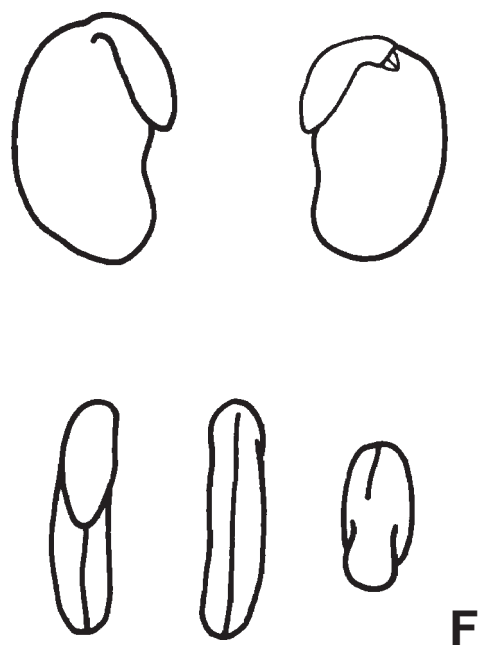
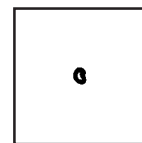
Seed $1.7\text{--}2 \times 1.1\text{--}1.2 \times 0.6\text{--}0.7$ mm; not overgrown; not angular; asymmetrical; reniform (sub-); compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome; reddish brown or tan; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum;

punctiform; marginal according to radicle tip; flush; within halo. Hilum halo color of testa. Lens discernible; less than 0.5 mm in length; with margins straight or curved; oblong; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; darker reddish brown; not within corona, halo, or rim. Endosperm thick; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: India to southern China and Malay Islands.

Notes: The seeds dehisce from the one-seeded fruits while on the plants. Apparently, the “bird-cage” heads fall intact, and the seeds are shed as the heads are transported on animal fur.

Mecopus: *M. nidulans* J.J. Bennett (A–F). A, “bird cage” (see Notes) ($\times 2.9$); B, fruits ($\times 10$); C, seeds ($\times 10$); D–E, testa ($\times 50$, $\times 1000$); F, embryos ($\times 20$).



Genus: *Uraria* A.N. Desvaux

Phylogenetic Number: 11.16.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 8 spp.—20 spp.

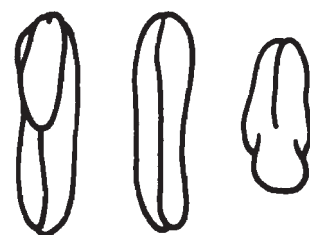
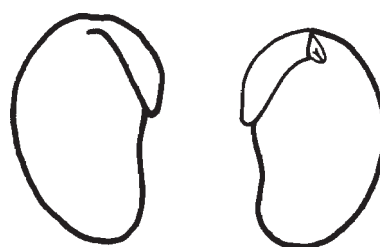
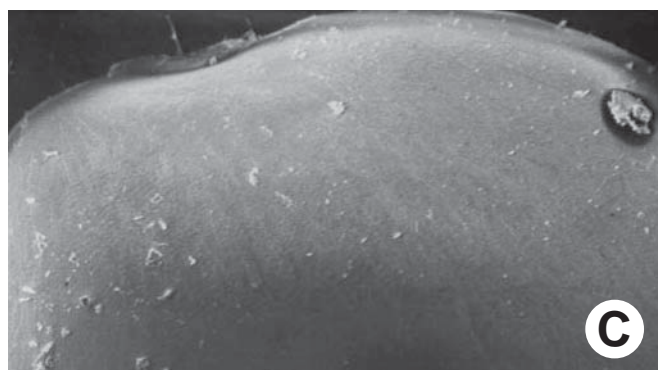
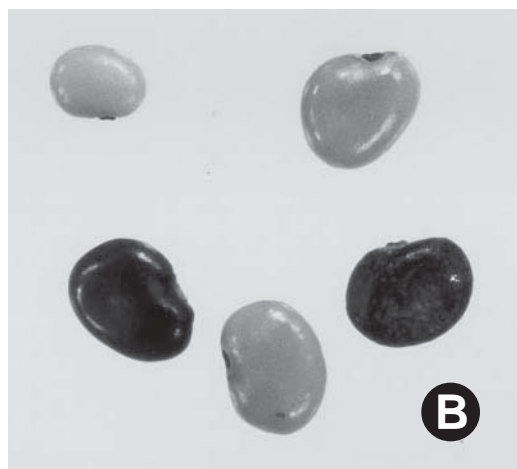
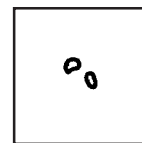
Fruit a loment (or loment segment); $0.3\text{--}0.9 \times 0.2\text{--}0.4 \times 0.1\text{--}0.2$ cm; with persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (or slightly curved); plicate or not plicate; not twisted; asymmetrical; oblong; when asymmetrical with both sutures parallelly curved or 1 straight and 1 curved suture; narrowing in several places, resembling *Desmodium* (11.9) fruit; not inflated; compressed or terete; without beak; rounded at apex; apex oblique with longitudinal axis of fruit; short tapered or rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit substipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 2.5–3.5 mm long; widest across seed area; with all essentially similar in shape; ovate. Epicarp dull or glossy; monochrome; brown, tan, black, or gray; glabrous (widely scattered hairs may be on sutures) or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence golden or gray (with straight-tipped or straight- and hooked-tipped hairs); with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating or exfoliating (*U. picta* leaving a shiny gray mesocarp); without cracks. Mesocarp present or absent; thin to very thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull or glossy; monochrome; brown (to grayish); smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; remaining fused to epicarp; entire. Seeds 2–6; length parallel or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; more or less thick; straight. Aril dry; rim-aril; reddish brown.

Seed $1.8\text{--}2.5 \times 1.5\text{--}2 \times 0.7\text{--}0.8$ mm; not overgrown; not angular or angular; asymmetrical; reniform, elliptic, mitaform, or triangular; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; dull or glossy; not modified by a bloom; colored; monochrome; yellowish to reddish brown or tan; glabrous; smooth; coriaceous. Fracture lines present or absent; reticulate. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform or larger than punctiform; to 0.5 mm long; with curved outline; oval; marginal according to radicle tip or between cotyledon and radicle lobe; slightly recessed; within halo (faint). Hilum halo color darker (slightly) than testa. Lens discernible; less than 0.5 mm in length; with margins straight or curved; rectangular or circular; not in groove of raphe; confluent with hilum or adjacent to hilum; 0.1 mm from hilum; mounded; dissimilar color from testa; darker than testa; reddish brown or black; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa or embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan or yellow; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear or bulbose; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

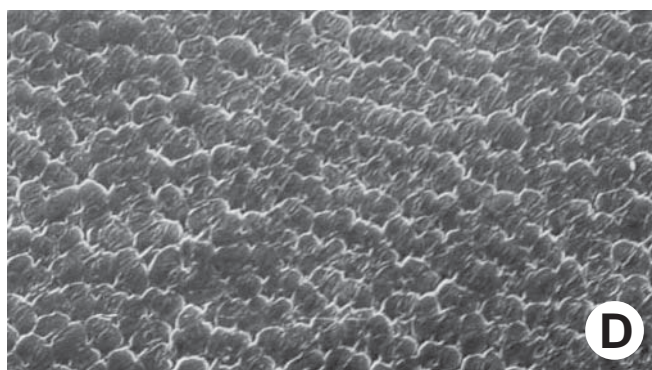
Distribution: Old World tropics.

Notes: *Urariopsis* Schindler (11.16) in Ohashi et al. (1981) is a synonym of *Uraria* (Haas et al. 1980). *Urariopsis cordifolia* (C.F.W. Wallroth) A.K. Schindler is based on *U. cordifolia* C.F.W. Wallroth. Jha and Pandey (1988) studied the seeds of *Uraria* and *Alysicarpus* (11.16 and 11.18).

Uraria: *U. picta* (N. von Jacquin) A.N. Desvaux ex A.-P. de Candolle (C–E), *U. spp.* (A–B). A, Fruits with calyxes and articles ($\times 4.7$); B, seeds ($\times 8.9$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 12$).



E



Genus: *Christia* C. Moench

Phylogenetic Number: 11.17.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 2 spp.—ca. 10 spp.

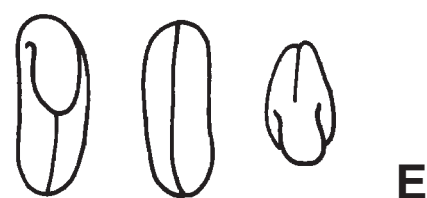
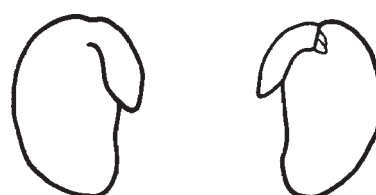
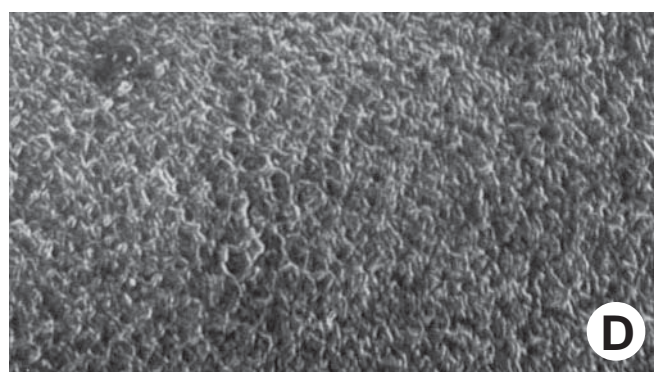
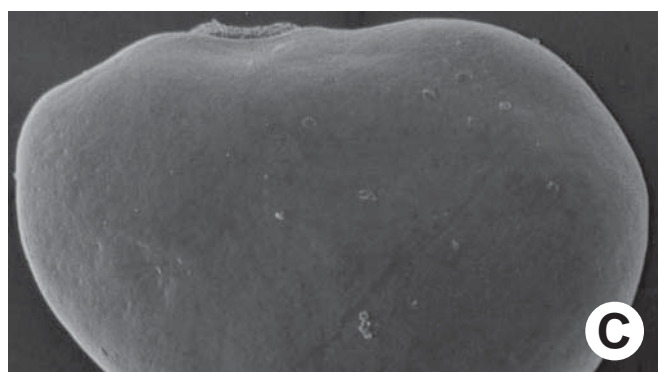
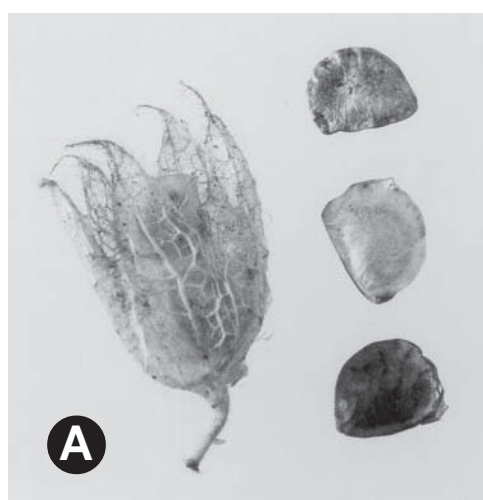
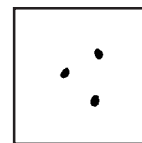
Fruit a loment (or loment segment); $0.6 \times 0.15 \times 0.1$ cm; with persistent calyx; with calyx longer or shorter than fruit; without orifice formed by curving of fruit or fruit segments; S-curved; plicate; not twisted; asymmetrical; irregular; when asymmetrical with 1 straight and 1 curved suture or both sutures unequally curved; narrowing in several places, resembling *Desmodium* (11.09) fruit (though folded); not inflated; flattened; without beak; truncate at apex; apex aligned with longitudinal axis of fruit; truncate at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous (easily eroding); seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted only on 1 margin; without sulcus; plain. Fruit wings absent. Fruit substipitate or nonstipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; 2 mm long; widest across seed area; with all essentially similar in shape; D-shaped. Epicarp dull; monochrome; gray, brown, or black; glabrous or pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray (with hooked tips); with pubescence uniformly distributed; with simple hairs (with hooked tips); pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; reddish brown or white; smooth; septate; with septa thin (tissue paper-like), flexible; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–3; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; thick; straight. Aril absent.

Seed $1.6\text{--}2.5 \times 1.2\text{--}1.8 \times 0.6\text{--}0.9$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; with or without visible radicle and cotyledon lobes; without external groove between radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored;

monochrome; dark to light reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; between cotyledon and radicle lobe; flush; within rim. Hilum rim color darker than testa. Lens discernible; less than 0.5 mm in length; with margins curved; circular or elliptic; not in groove of raphe; confluent with hilum; slightly mounded; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons not smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; lobe tip straight; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Tropical and subtropical Asia and Australasia.

Christia: *C. obcordata* (J.L.M. Poiret) R.C. Bakhhuizen van den Brink (*C–E*), *C. spp.* (*A–B*). *A*, Fruit in calyx and articles ($\times 5.5$); *B*, seeds ($\times 10.5$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 19$).



Genus: *Alysicarpus* A.N. Desvaux

Phylogenetic Number: 11.18.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 11 spp.—25–30 spp.

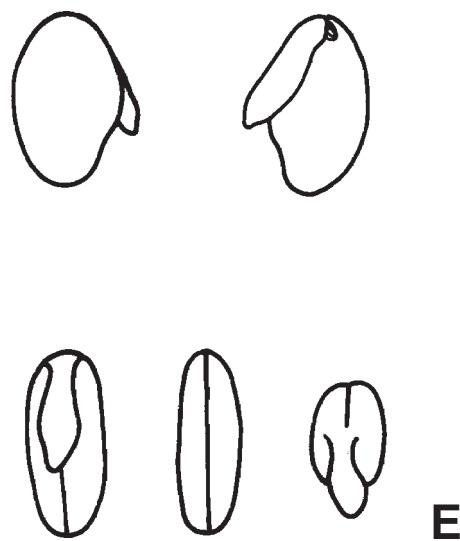
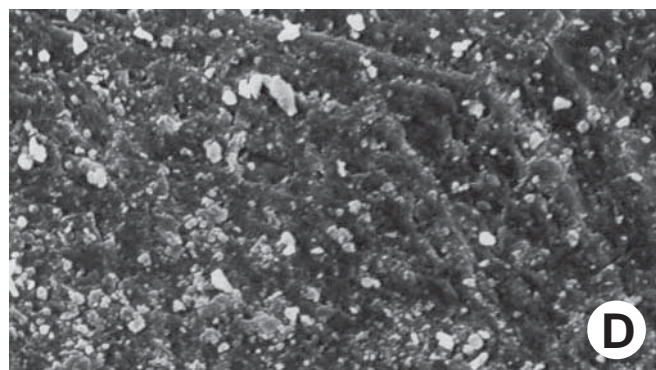
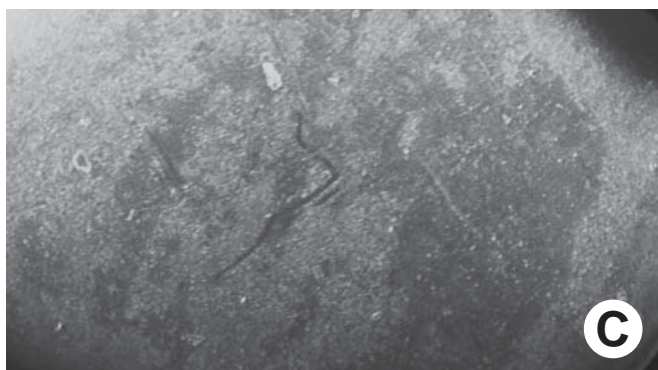
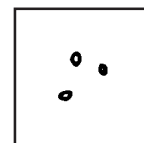
Fruit a loment (or loment segment) or legume; unilocular; $0.5\text{--}2.5 \times 0.1\text{--}0.3 \times 0.1\text{--}0.2$ cm; with persistent or deciduous calyx; with calyx longer than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; linear, moniliform, or oblong; when asymmetrical with 1 straight and 1 curved suture; widest near middle or D-shaped or narrowing in several places, resembling *Desmodium* (11.09) fruit; not inflated; terete; without or with beak; straight; with solid beak the same color and texture as fruit; rounded at apex; apex aligned with longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible; with the raised seed chambers torulose or not torulose. Fruit margin constricted or not constricted; constricted along both margins; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Loment indehiscent or dehiscent along 1 suture (somewhat). Loment segments (articles) conspicuous; 1–4 mm long; widest across seed area; with all essentially similar in shape; rectangular or quadrangular. Epicarp dull; monochrome or multicolored; bichrome; brown (to dirty-, greenish-, dark-, or reddish-brown), tan, or black; with brown (reddish) overlay; pubescent and indurate or glabrous; with hairs erect or appressed; puberulent; with pubescence gray; with simple hairs (with hooked tips that are easily broken off); pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined or transversely veined relative to fruit length; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; brown; smooth; septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seeds 1–8; length parallel or transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; filiform; straight. Aril absent.

Seed $1.5\text{--}2.5 \times 1.2\text{--}1.8 \times 0.8\text{--}1.2$ mm; not overgrown; not angular; symmetrical; elliptic (and oblong), oblong, rhombic (rounded), quadrangular, or circular (to sub-); slightly compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome or mottled (faint to conspicuous); with frequent mottles; reddish brown, tan (and greenish- to reddish-tan), yellow, or black; with brown (reddish) or purple overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed or visible; concealed by funiculus; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; marginal according to radicle tip; flush; within rim or within halo. Hilum halo color of testa (essentially). Hilum rim color of testa. Lens discernible; equal to or greater than 0.5 mm in length; 0.3 mm long; with margins straight or curved; linear; more or less circular; not in groove of raphe; confluent with hilum; flush; dissimilar color from testa; darker than testa; dark reddish brown; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa or embryo. Cotyledons not smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; partially concealing or not concealing radicle; entire over radicle; without or with lobes; with lobes not touching; without basal groin formed by lobes; with the interface division terminating at base of radicle; without margins recessed; yellow or white; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length or width; centered between cotyledons; 1/2 to nearly length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Old World tropics with *A. vaginalis* (C. Linnaeus) A.-P. de Candolle a worldwide crop.

Notes: Jha and Pandey (1988) studied seeds of *Alysicarpus* and *Uraria* (11.16).

Alysicarpus: *A. rugosus* (C.L. von Willdenow) A.-P. de Candolle (C–E), *A. spp.* (A–B). A, Fruits (with and without calyx) and articles ($\times 3.4$); B, seeds ($\times 8.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 8$).



Genus: *Desmodiastrum* (D. Prain) A. Pramanik & K. Thothathri

Phylogenetic Number: 11.18A.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 1 sp.—2 spp.

Fruit a loment (or loment segment); $0.8\text{--}1.5 \times 0.35\text{--}0.5$ cm; with persistent calyx; with calyx shorter or longer than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; moniliform; when asymmetrical with both sutures parallelly curved (nearly so) or 1 straight and 1 curved suture; narrowing in several places, resembling *Desmodium* (11.09) fruit; not inflated; flattened; with beak; nearly straight; with solid beak the same color and texture as fruit; short tapered or rounded at apex; apex aligned with longitudinal axis of fruit; rounded at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin constricted only on 1 margin; without sulcus; plain. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Loment indehiscent. Loment segments (articles) inconspicuous; widest across seed area; with all essentially similar in shape; D-shaped. Epicarp dull; monochrome; brown (assumed); pubescent and indurate; with hairs appressed; with 1 type of pubescence; with pubescence uniformly distributed; with simple hairs (mixture of hooked and plain tipped hairs); pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp present or absent (assumed to be like *Desmodium* (11.09)). Endocarp septate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 3–6; length parallel with fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only. Aril absent.

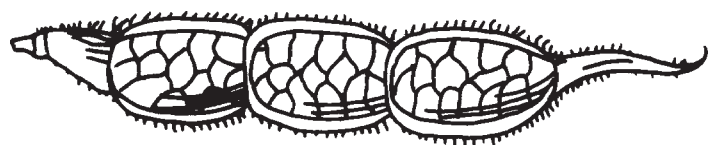
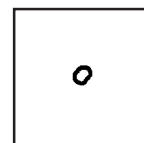
Seed $1.2\text{--}2 \times 1.2\text{--}2$ mm; not overgrown; not angular; asymmetrical; reniform or ovate; compressed; with surface smooth; with visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by

a bloom; colored; monochrome; dark brown or gray (dark); glabrous; smooth; coriaceous (assumed). Fracture lines absent. Rim present. Wings absent.

Distribution: India, Indochina, Indonesia.

Notes: Pramanik and Thothathri (1986) raised *Alysicarpus* subgenus *Desmodiastrum* to the genus level. We were unable to obtain fruits and seeds and instead used Pramanik and Thothathri's text and the plate from Wight (1838) for our figure.

Desmodiastrum: *D. belgaumense* (W. Wight) A. Pramanik & K. Thothathri (A–B). A, Fruit ($\times 4.5$); B, seed ($\times 10$), both from Wight (1838).



A



B

Genus: *Melliniella* H.A.T. Harms

Phylogenetic Number: 11.19.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 1 sp.—1 sp.

Fruit a legume; unilocular; $1-1.3 \times 0.2 \times 0.5-0.7$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; slightly curved or straight; not plicate; not twisted; asymmetrical; C-shaped or linear; when asymmetrical with both sutures parallelly curved or nearly straight; not inflated; compressed; with beak; with solid beak the same color and texture as fruit; short tapered or tapered at apex; apex oblique or aligned with longitudinal axis of fruit; tapered at base; base oblique or aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit substipitate or nonstipitate. Fruit with all layers dehiscing; splitting along suture. Dehiscence of valves along 1 suture; apical and down; passive. Replum invisible. Epicarp dull; monochrome; brown or tan; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs (with hooked tips); pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; transversely veined relative to fruit length and reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull or glossy; monochrome; brown; smooth; septate or nonseptate; with septa thicker than paper, firm; with septa eglandular; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seeds 5–8; length transverse to fruit length; neither overlapping nor touching; in 1 series. Funiculus less than 0.5 mm long; of 1 length only; filiform; straight. Aril present (but difficult to see) or absent; dry; rim-aril; reddish brown or tan.

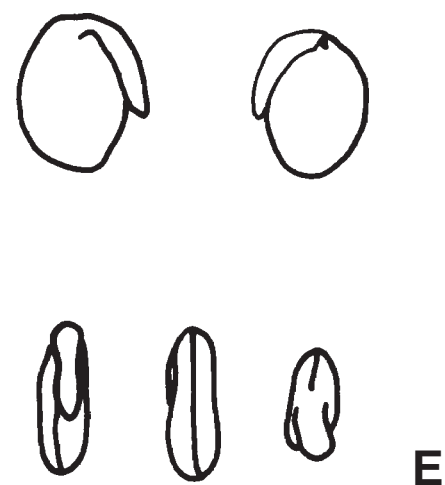
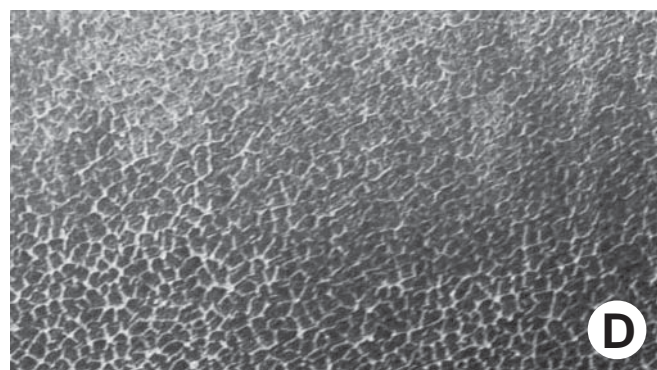
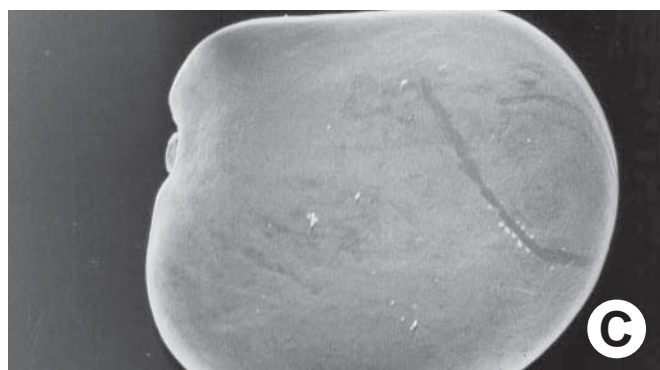
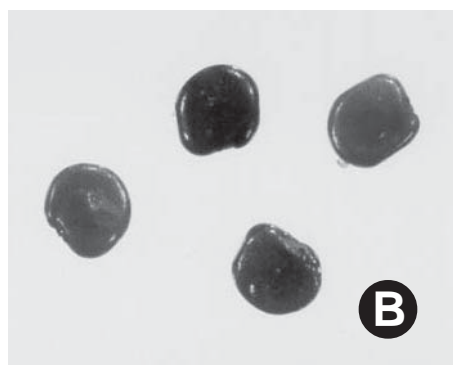
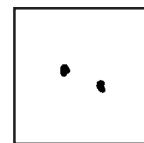
Seed $1.2-1.3 \times 1.1-1.2 \times 0.6-0.7$ mm; not overgrown; not angular; asymmetrical; mitaform or oblong; compressed; with surface smooth; with visible radicle and

cotyledon lobes; with external groove between radicle and cotyledon lobes; with external groove between radicle and cotyledon lobes same color as testa; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; reddish brown or tan; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible (but difficult to see because of size and color); with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform; between cotyledon and radicle lobe; flush; within rim. Hilum rim color of testa. Lens discernible or not discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; confluent with hilum; mounded; dissimilar color from or similar color as testa; darker than testa; black or brown (darker reddish); not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; 1/2 to nearly length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Western tropical Africa.

Notes: Harms (1914) founded the genus and provided fruit and seed drawings. Ohashi et al. (1981) noted that *Melliniella* is “a minor segregate of *Alysicarpus*” (11.18).

Melliniella: *M. micrantha* H.A.T. Harms (A–E). A, Fruits with and without calyx ($\times 6.4$); B, seeds ($\times 13.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 15$).



Genus: *Leptodesmia* G. Bentham

Phylogenetic Number: 11.20.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 4 spp.—6 spp.

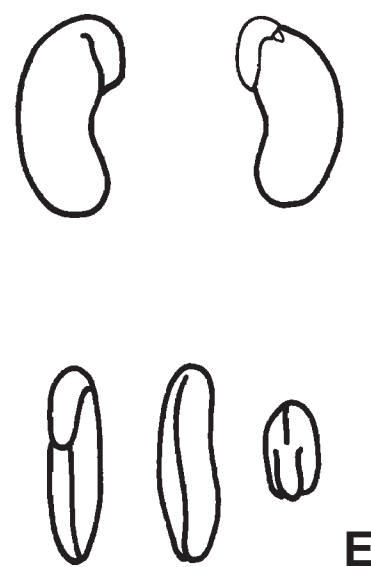
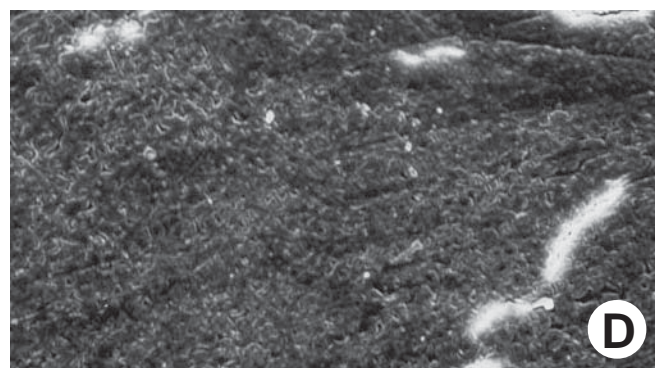
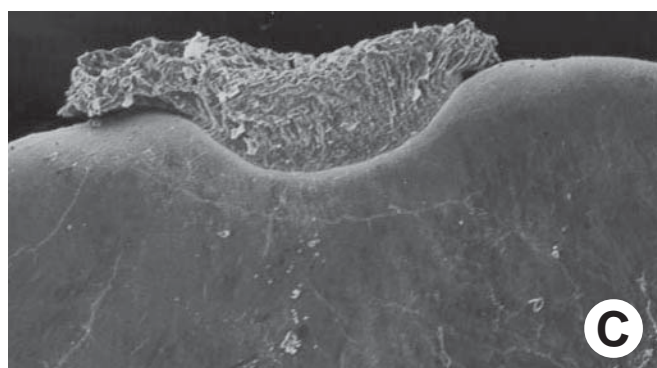
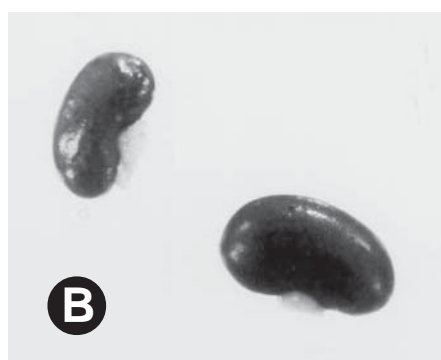
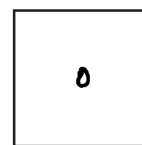
Fruit a legume; unilocular; $0.4\text{--}0.5 \times 0.25 \times 0.05$ cm; with persistent calyx; with calyx longer than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; oblong; when asymmetrical with both sutures parallelly curved; not inflated; flattened; without beak; rounded at apex; apex oblique to right-angled with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; coriaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit with all layers dehiscing; splitting along suture. Dehiscence of valves along 1 suture; medial and up and down; active; with valves reflexing. Replum invisible. Epicarp dull; monochrome; reddish brown; pubescent and indurate; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; golden brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; flattened; straight. Aril fleshy; cupshaped; covering less than 1/2 of seed; reddish brown or cream.

Seed $2\text{--}2.5 \times 1\text{--}1.5 \times 0.5\text{--}0.8$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; mottled and streaked or monochrome; with frequent mottles; with frequent streaks; dark to lighter reddish brown, green, or olive; with black overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum fully concealed; concealed by aril;

with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than punctiform; 0.5 mm long; with curved outline; elliptic; marginal according to radicle tip; flush; within rim. Hilum rim color of testa. Lens discernible (under aril); less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; confluent with hilum; mounded; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons or 1/2 to nearly length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Madagascar (5 spp.) and India (*L. congesta*).

Leptodesmia: *L. congesta* G. Bentham ex J.G. Baker (*C–E*), *L. spp.* (*A–B*). *A*, Fruits with and without calyx ($\times 8$); *B*, seeds ($\times 10.9$); *C–D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 10$).



Genus: *Eleiotis* A.-P. de Candolle

Phylogenetic Number: 11.21.

Tribe: Desmodieae.

Subtribe: Desmodiinae.

Species Studied—Species in Genus: 1 sp.—2 spp.

Fruit a legume; unilocular; $0.6\text{--}0.65 \times 0.2\text{--}2.5 \times 0.1\text{--}0.15$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; C-shaped; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near middle or D-shaped; not inflated; compressed; with or without beak; straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible; with the raised seed chambers not torulose. Fruit margin not constricted; with sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome or multicolored; mottled and streaked; reddish brown or purple; with green overlay; glabrous (at first glance glabrous but with careful examination puberulent) or pubescent and indurate; with 1 type of pubescence; puberulent (tiny hairs); with pubescence gray; with pubescence uniformly distributed; pliable; with hair bases plain; glandular or eglandular; with glandular dots (absent to numerous); without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp present or absent; trace or thin (very); surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; flattened; straight. Aril present (inconspicuous) or absent; dry; rim-aril and tongue-aril; reddish brown.

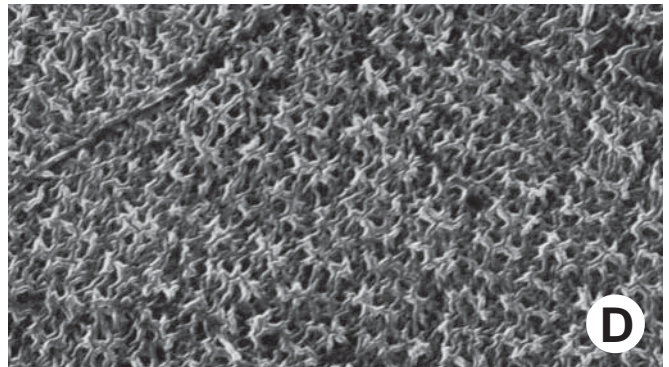
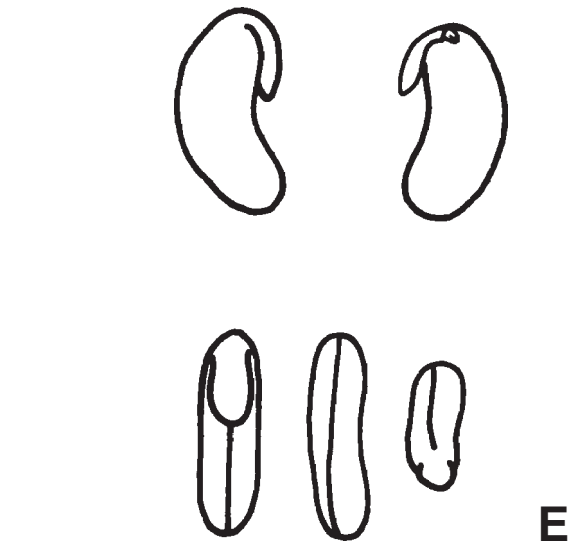
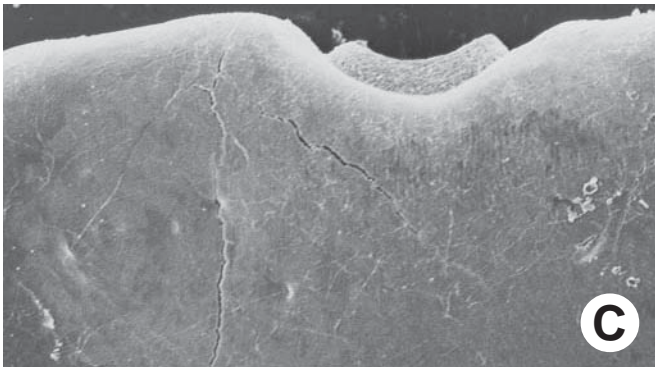
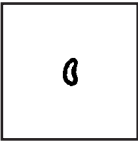
Seed $4 \times 2.7 \times 1\text{--}1.1$ mm; not overgrown; not angular; asymmetrical; reniform (sub-) or oblong; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on

seed faces. Testa not adhering to endocarp; dull; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; very dark reddish brown, black, tan (greenish), or green; with purple overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 0.5 mm long; with straight outline; oblong; marginal according to radicle tip; flush; within halo. Hilum halo color darker than testa. Lens discernible; less than 0.5 mm in length or equal to or greater than 0.5 mm in length; 0.5 mm long; with margins curved; circular; not in groove of raphe; confluent with hilum; mounded; dissimilar color from or same color as testa; darker than testa; very dark reddish brown, blackish, or tan (greenish); not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; completely concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule moderately developed; glabrous.

Distribution: India.

Notes: Based on its fruit characters (presence or absence of hairs and glandular dots), *Eleiotis monophylla* may be a mixed species.

Eleiotis: E. monophylla (N.L. Burman) A.-P. de Candolle (A–E). A, Fruits ($\times 7.8$); B, seeds ($\times 10.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).



Genus: *Phylacium* J.J. Bennett

Phylogenetic Number: 11.22.

Tribe: Desmodieae.

Subtribe: Lespedezinae.

Species Studied—Species in Genus: 2 spp.—2 spp.

Fruit a legume; unilocular; $0.7\text{--}1.2 \times 0.4\text{--}0.6 \times 0.15\text{--}0.2$ cm; with persistent or deciduous calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical; when asymmetrical with 1 straight and 1 curved (more or less) suture; widest near middle or D-shaped (more or less); not inflated; flattened; with beak; declined (especially, tip of *P. bracteosum* J.J. Bennett) or coiled (especially tip of *P. majus*); with solid beak the same color and texture as fruit; short tapered at apex; apex aligned or oblique with longitudinal axis of fruit (especially tip); short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; reddish brown to brown; pubescent and indurate; with hairs erect or appressed; with 1 type of pubescence; puberulent; with pubescence gray; with pubescence uniformly distributed; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp thin; surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; coriaceous. Endocarp dull; monochrome; reddish brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; filiform or thick and triangular; straight. Aril dry; rim-aril; reddish brown to brown.

Seed $4\text{--}5 \times 1.5\text{--}3 \times 2\text{--}2.2$ mm; not overgrown; not angular; symmetrical; reniform, circular, or ovate; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering or partially adhering to endocarp (very thin layer *P. majus*); dull; not modified by a bloom; colored; monochrome (but with very thin reddish-brown

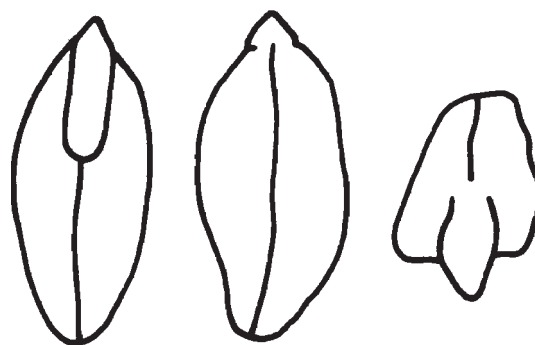
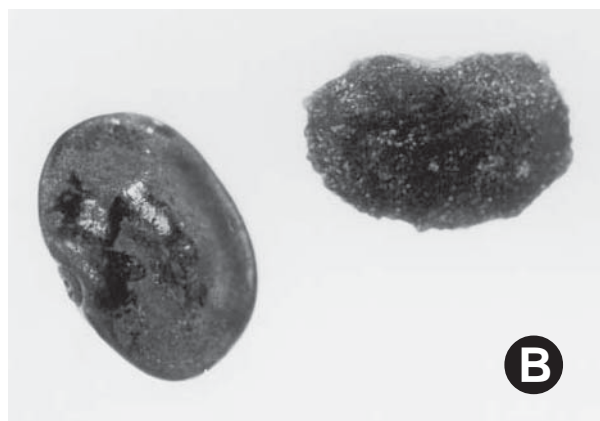
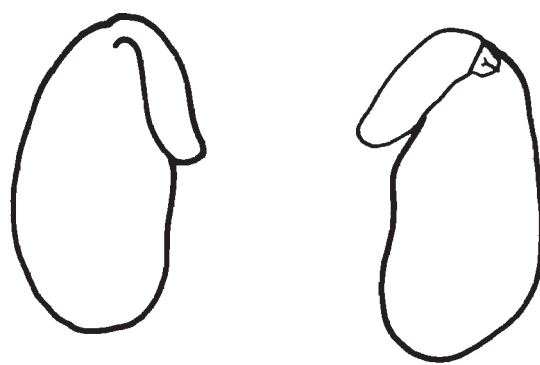
endocarp layer *P. majus*); black, purple, pale pink, or yellow; glabrous; smooth (shagreen) or not smooth; with elevated features; shagreen and warty (small); coriaceous. Fracture lines absent. Rim absent. Wings present. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; larger than punctiform; 1 mm long; with curved outline; elliptic; marginal according to radicle tip or between cotyledon and radicle lobe; slightly recessed; not within corona, halo, or rim or within halo. Hilum halo color lighter than testa. Lens discernible; less than 0.5 mm in length or equal to or greater than 0.5 mm in length; 0.5 mm long; with margins straight or curved; more or less triangular; elliptic; not in groove of raphe; confluent with hilum; mounded; same color as testa; not within corona, halo, or rim. Endosperm thick; covering entire embryo; adnate to embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish brown or red; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: China, Indochina, and Philippines to Australia (northern Queensland).

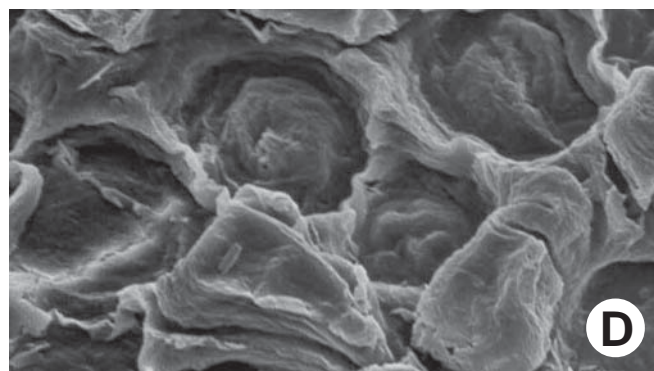
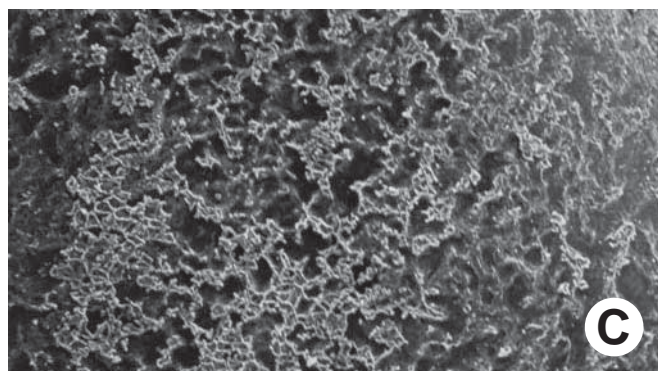
Notes: Bresser (1978) monographed the genus and carefully described the “most striking” feature of the inflorescences: “Large pale green bracts, which cover the fruits and the old flowers.” Figure A was lighted from the back to show the two fruits inside the bracts. There may be one to three fruits in each set of bracts, and this unit may function as a “winged fruit.” Bailey et al. (1997), using the chloroplast *rpl2* intron, suggested that *Phylacium* is not a member of Desmodieae, but did not indicate where it should be placed.

Phylacium: *P. majus* H. Collett & W.B. Hemsley (C–E), *P.* spp. (A–B). A, Fruits within large bracts and a freed fruit (see Notes) ($\times 1.7$); B, seeds ($\times 9$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).

0



E



Genus: *Campylotropis* A.A. von Bunge

Phylogenetic Number: 11.23.

Tribe: Desmodieae.

Subtribe: Lespedezinae.

Species Studied—Species in Genus: 15 spp.—ca. 65 spp.

Fruit a legume; unilocular; $0.8\text{--}1.5 \times 0.4\text{--}0.5 \times 0.05\text{--}0.07$ cm; with deciduous or persistent calyx; with calyx shorter than fruit; without orifice formed by curving of fruit or fruit segments; straight or curved (slightly); not plicate; not twisted; asymmetrical or symmetrical; oblong; when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near middle or D-shaped; not inflated; flattened; without or with beak; straight; with solid beak the same color and texture as fruit; rounded or short tapered at apex; apex aligned with longitudinal axis of fruit; tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain. Fruit wings present. Fruit substipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; brown; pubescent and indurate or glabrous (except for stiff hairs along sutures); with hairs erect or appressed; with 1 type of pubescence; pilose; with pubescence brown (to reddish) or golden; with pubescence uniformly distributed; with simple hairs; pliable or stiff (golden hairs along sutures); with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp glossy; monochrome; reddish brown; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; thick; straight. Aril absent.

Seed $3.7\text{--}4.5 \times 2\text{--}2.5 \times 1.3\text{--}1.5$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without visible radicle and cotyledon lobes; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome; reddish brown; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; larger than

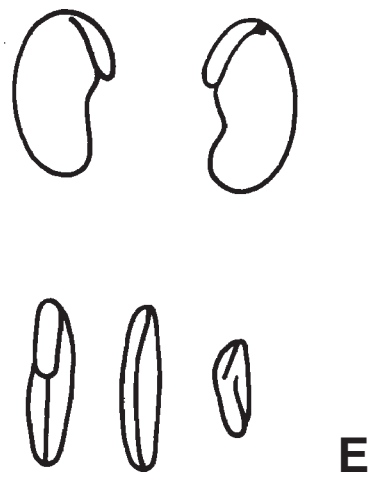
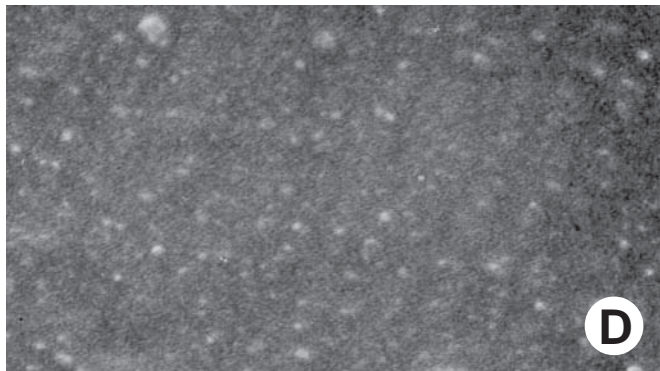
punctiform; 0.4 mm long; with curved outline; circular; marginal according to radicle tip; flush; within rim, or within halo (halo absent or faintly present). Hilum halo color darker than testa. Hilum rim color of testa. Lens discernible; less than 0.5 mm in length; with margins curved; elliptic; not in groove of raphe; confluent with hilum (or nearly so); flush; dissimilar color from testa; darker than testa; black; not within corona, halo, or rim. Endosperm absent. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; reddish to greenish brown; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than 1/2 length of cotyledons. Plumule rudimentary; glabrous.

Distribution: Asia.

Notes: Ohashi (1974a,b,c) published a trio of papers on *Campylotropis*, and Fu (1987) recognized 29 species in the People's Republic of China. Akiyama and Ohba (1985) and Nemoto and Ohashi (1988) maintained *Campylotropis*, *Kummerowia* (11.25), and *Lespedeza* (11.24) as distinct genera.

Campylotropis: *C. macrocarpa* (A.A. von Bunge) A. Rehder (*C-E*), *C. spp.* (*A-B*). *A*, Fruits (with and without calyx) ($\times 4.3$); *B*, seeds ($\times 6.3$); *C-D*, testa ($\times 50$, $\times 1000$); *E*, embryos ($\times 5$).

6



Genus: *Lespedeza* A. Michaux

Phylogenetic Number: 11.24.

Tribe: Desmodieae.

Subtribe: Lespedezinae.

Species Studied—Species in Genus: 30 spp.—ca. 40 spp.

Fruit a legume; unilocular; $0.25 \times 0.2\text{--}0.4 \times 0.1\text{--}0.2$ cm; with persistent or deciduous calyx; with calyx shorter than or equal in length to fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; asymmetrical or symmetrical; elliptic, oblong, ovate, circular, linear (somewhat), or C-shaped (slightly); when asymmetrical with 1 straight and 1 curved suture or both sutures parallelly curved; widest near middle or D-shaped; not inflated; compressed; with or without beak; hooked or straight; with solid beak the same color and texture as fruit; short tapered at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; membranous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain or embellished; with fringe (of hairs). Fruit wings absent. Fruit substipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; reddish brown, tan (to greenish), green, or gray (because of hairs); pubescent and indurate, pubescent but soon deciduous, or glabrous; with hairs appressed (often missing from center of each valve) or erect; with 1 type of pubescence; puberulent; with pubescence gray or with pubescence golden; with apical pubescence different from basal pubescence; with apical $1/3\text{--}1/2$ pubescent and basal $1/2\text{--}2/3$ glabrous; with simple hairs (either straight or somewhat hooked at apex); pliable or stiff; with hair bases plain; antrorse; straight or curved at apex; eglandular; without spines; not smooth; with elevated features; reticulately veined; not tuberculate; not exfoliating; without cracks. Mesocarp present or absent; trace or thin (usually very); surface not veined; 1-layered; without balsamic vesicles; without fibers; solid; chartaceous. Endocarp dull; monochrome; reddish brown or tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to mesocarp and epicarp; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long or measured; up to 1 mm long; flattened, thick, or partially filiform and partially thick; curved or straight. Aril dry; rim-aril; tan.

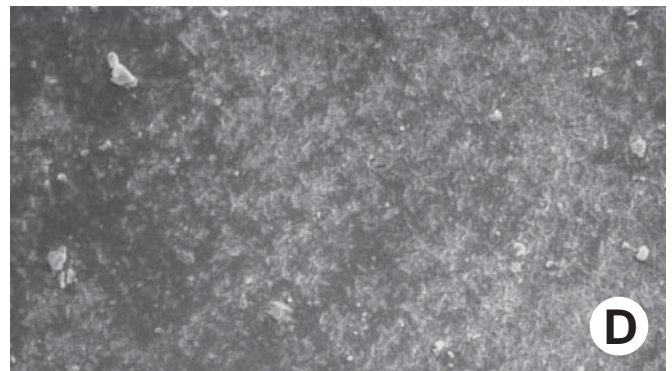
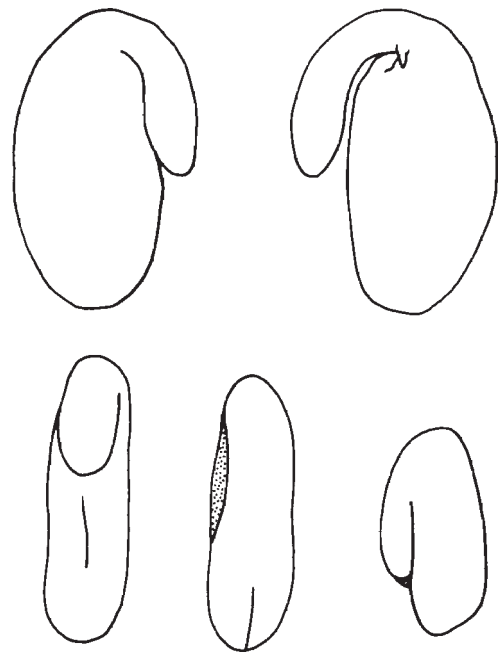
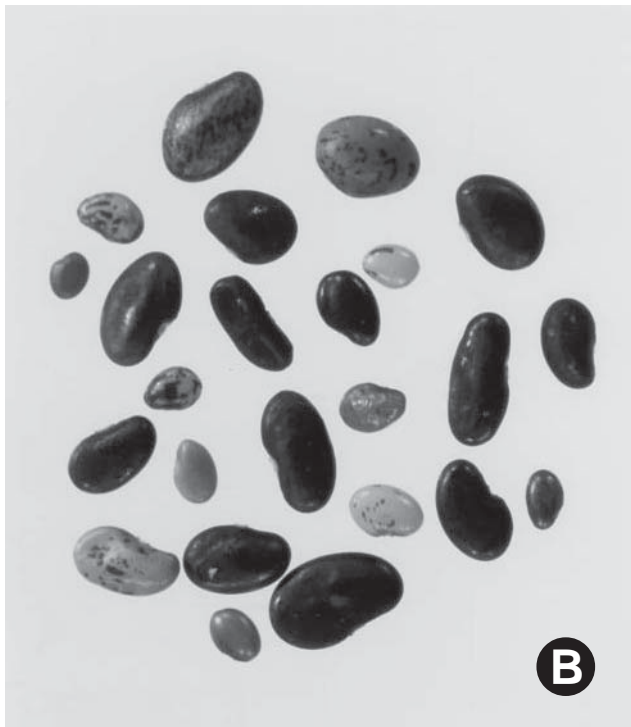
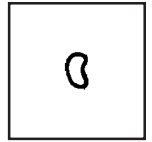
Seed $1.5\text{--}5 \times 1.3\text{--}3 \times 0.7\text{--}1.5$ mm; not overgrown; not angular; asymmetrical; reniform; compressed; with surface smooth; without or with visible radicle and cotyledon lobes; without or with external groove between radicle and cotyledon lobes; same color as testa; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy or dull; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; light to dark reddish brown, tan, purple, yellow (greenish), green, or black; with purple overlay; glabrous; smooth; coriaceous. Fracture lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split the same color as the rest of the hilum; punctiform or larger than punctiform; $0.3\text{--}0.6$ mm long; with straight outline; oblong; marginal according to radicle tip; recessed; within halo. Hilum halo color lighter or darker than testa. Lens discernible; less than 0.5 mm in length; with margins straight or curved; oblong, wedge-shaped, or linear (somewhat and with or without medial groove); circular or oblong; not in groove of raphe; confluent with or adjacent to hilum; up to 0.2 mm from hilum; flush; dissimilar color from testa; darker or lighter than testa; black or tan; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa or embryo. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; white, yellow, green, or tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon length; centered between cotyledons; less than $1/2$ length of cotyledons. Plumule moderately developed or rudimentary; glabrous.

Distribution: Temperate North America, eastern and tropical Asia, and Australia.

Notes: Akiyama (1988) monographed section *Macrolespedeza*, and Akiyama and Ohba (1988) revised *Lespedeza formosa* (J.R.T. Vogel) B.A.E. Koehne. Clewell (1966) monographed the native species of *Lespedeza* in North America. Although cleistogamous and chasmogamous flowers may produce slightly different fruits, these differences do not affect the genus circumscription of the fruits and seeds. Nemoto and Ohashi (1993) studied *Lespedeza*

seedling morphology and presented excellent SEM illustrations of the embryo and plumule. They found that the first pair of plumule leaves are either opposite or alternate and that their relative position is positively correlated with the subgeneric classification. *Lespedeza stipulacea* C.J. Maximowicz and *L. striata* C.P. Thunberg are now in the segregate genus *Kummerowia* (11.25). Akiyama and Ohba (1985) and Nemoto and Ohashi (1988) maintained *Campylotropis* (11.23), *Kummerowia* (11.25), and *Lespedeza* as distinct genera. Nemoto et al. (1995), using morphological and molecular evidence, concluded that “*Lespedeza* is closer to *Kummerowia* than to *Campylotropis*.”

Lespedeza: *L. virginica* (C. Linnaeus) N.L. Britton (*C–E*),
L. spp. (*A–B*). *A*, Fruits (with and without calyx) (\times
2.8); *B*, seeds (\times 4.7); *C–D*, testa (\times 50, \times 1000); *E*,
embryos (\times 13).



Genus: *Kummerowia* A.K. Schindler

Phylogenetic Number: 11.25.

Tribe: Desmodieae.

Subtribe: Lespedezinae.

Species Studied—Species in Genus: 2 spp.—2 spp.

Fruit a legume; unilocular; $0.28\text{--}0.45 \times 0.15\text{--}0.23 \times 0.1\text{--}0.13$ cm; with persistent or deciduous calyx; with calyx shorter than or equal (nearly) in length to fruit; without orifice formed by curving of fruit or fruit segments; straight; not plicate; not twisted; symmetrical; oblong; not inflated; compressed; without beak; short tapered at apex; apex aligned with longitudinal axis of fruit; short tapered at base; base aligned with longitudinal axis of fruit; with the apex and base uniform in texture; chartaceous; seed chambers externally visible. Fruit margin not constricted; without sulcus; plain. Fruit wings absent. Fruit nonstipitate. Fruit indehiscent. Replum invisible. Epicarp dull; monochrome; brown or tan; pubescent but soon deciduous, pubescent and indurate, or glabrate; with hairs appressed or erect; with 1 type of pubescence; velutinous; with pubescence gray; with pubescence uniformly distributed or with apical pubescence different from basal pubescence; with apical $1/3\text{--}1/2$ pubescent and basal $1/2\text{--}2/3$ glabrous; with simple hairs; pliable; with hair bases plain; eglandular; without spines; not smooth; with elevated features; reticulately veined; tuberculate; not exfoliating; without cracks. Mesocarp absent. Endocarp dull; monochrome; tan; smooth; nonseptate; chartaceous; not exfoliating; remaining fused to epicarp; entire. Seed 1; length parallel with fruit length. Funiculus less than 0.5 mm long; more or less filiform; curved. Aril present (barely visible) or absent; dry; rim-aril; reddish tan or brown (reddish).

Seed $1.5\text{--}2.3 \times 1.5\text{--}1.8 \times 0.8\text{--}1$ mm; not overgrown; not angular; symmetrical (except hilum); oblong, ovate, or elliptic; compressed; with surface smooth; with visible radicle and cotyledon lobes; with external groove between radicle and cotyledon lobes; with external groove between radicle and cotyledon lobes same color as testa; without hilar sinus; without umbo on seed faces. Testa not adhering to endocarp; glossy; not modified by a bloom; colored; monochrome or mottled and streaked; with frequent mottles; with frequent streaks; dark reddish brown or tan (reddish); with purple overlay; glabrous; smooth; coriaceous. Fracture

lines absent. Rim absent. Wings absent. Raphe not visible. Hilum visible; with faboid split; with the lips of the faboid split lighter colored than the rest of the hilum and therefore conspicuous; punctiform or larger than punctiform; 0.3 mm long; with curved outline; circular; between cotyledon and radicle lobe or subapical to radicle tip; flush; within halo. Hilum halo color lighter than testa. Lens discernible; less than 0.5 mm in length; with margins curved; circular; not in groove of raphe; confluent with hilum; recessed; dissimilar color from testa; darker or lighter than testa; reddish brown, tan (greenish), or green; not within corona, halo, or rim. Endosperm thin; covering entire embryo; adnate to testa. Cotyledons smooth; both outer faces convex; both the same thickness; both more or less of equal length; not folded; margin entire 180 degrees from base of radicle; similar at apex; not concealing radicle; entire over radicle; without lobes; with the interface division terminating at base of radicle; without margins recessed; tan; inner face flat; glabrous around base of radicle. Embryonic axis deflexed; oblique to length of seed; without a joint evident between the radicle and the cotyledons. Radicle linear; deflexed and parallel to cotyledon width; centered between cotyledons; $1/2$ to nearly length of cotyledons. Plumule moderately developed; glabrous.

Distribution: Asia and naturalized in temperate North America.

Notes: Isely (1948) discussed the two species of annual *Lespedeza* naturalized in the United States, which now are placed in the genus *Kummerowia*. Akiyama and Ohba (1985) and Nemoto and Ohashi (1988) maintained *Campylotropis* (11.23), *Kummerowia*, and *Lespedeza* (11.24) as distinct genera.

Kummerowia: *K. stipulacea* (C.J. Maximowicz) T. Makino (C–E), *K. spp.* (A–B). A, Fruits with and without calyx ($\times 8.7$); B, seeds ($\times 9.3$); C–D, testa ($\times 50$, $\times 1000$); E, embryos ($\times 10$).

